# Beechcraft®

# Twin-Bonanza

MODEL **B50**

# MAINTENANCE MANUAL

Beech Aircraft Corporation Wichita, Kansas

model B fifty

# MAINTENANCE

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Revisions to this handbook are published for two basic reasons: First, to notify operators of improved techniques which may have been evolved since the original publication, and second, to describe production changes which have been made between model changes and which affect the utility or operating procedures of the airplane.

Each revised page carries a revision date and the revised matter on that page, except when it constitutes more than half the page or is a minor typographical correction or an illustration, is indicated by a black vertical rule in the margin beside the new text. In the list above appear all the revised pages issued against this book, with their current revision dates: The pages revised in succeeding revisions likewise will be listed on this page, so that it becomes a running record of revisions and a convenient method of checking the current status of the handbook. To keep the handbook up to date, insert the revised pages in their proper place, discarding the pages superseded by the current revision.

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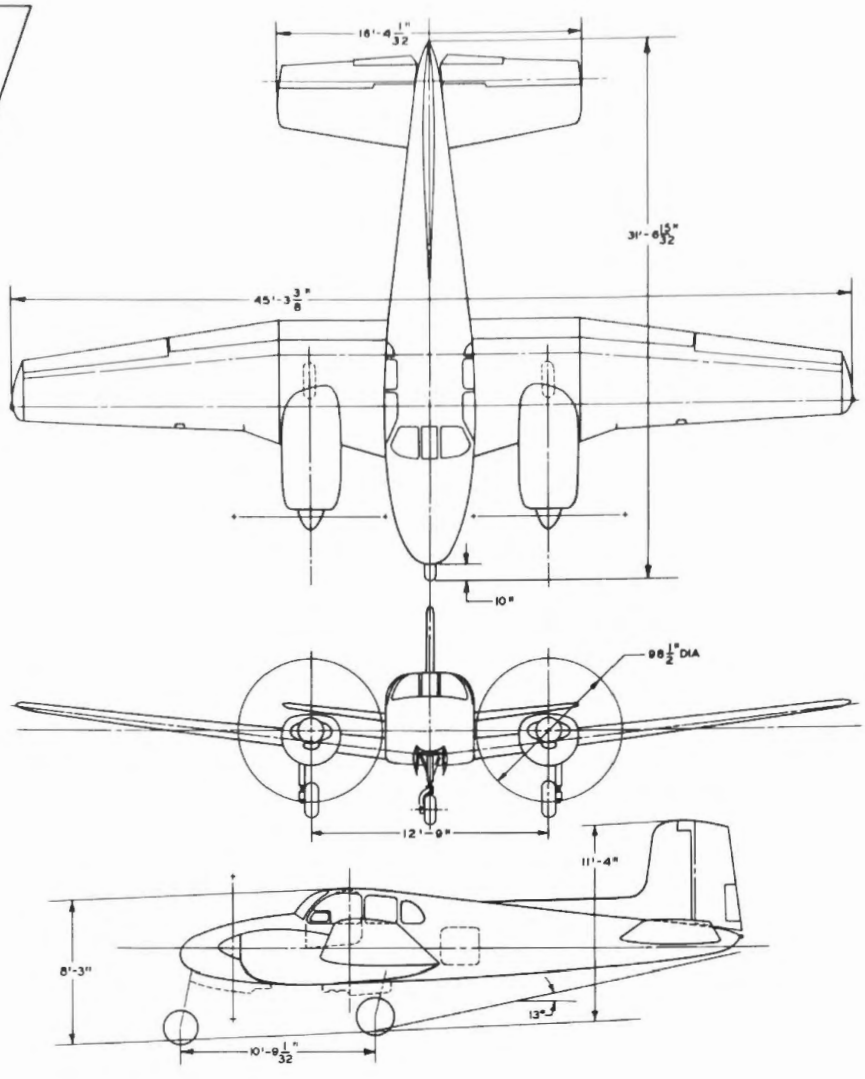
# INTRODUCTION

This handbook is intended as a guide in maintaining the BEECHCRAFT Model B-50. Recommended maintenance procedures have been grouped into seven individual text sections and a section of schematic wiring diagrams of the electrical circuits used in the airplane. The text sections cover the basic airframe and its related systems and components, each section containing both general descriptive data and specific instructions. Each section has been numbered within itself to facilitate incorporating periodic revision pages.

The illustrations in this manual which show the routing of cables, plumbing and wiring harnesses are intended to give the reader a simplified, overall picture of the systems portrayed, in relation to the rest of the airplane. To achieve this purpose within the limits of a printed page, many details have been omitted while the relative sizes of other items have been changed and, occasionally, detail sections have been rotated in plane. These illustrations are provided only for reference in connection with the descriptive text, and not as the basis for any maintenance operations. They are unsuitable, and were not intended, for use as rigging or reassembly guides. Never use them for such purposes.

Occasionally, when a specific adjustment or assembly procedure lends itself to pictorial presentation a line drawing or photograph has been used, with specific information on its face regarding points of measurement, adjusting points or procedures, or similar data. Such information, specifically stated, may be accepted as valid for direct use in accomplishing the specific procedure indicated.

model B fifty



Three View Dimensional

## 1.1 GENERAL DESCRIPTION

The Model B-50 BEECHCRAFT is an all-metal, twin-engine, low-wing monoplane powered by Lycoming GO435-C2 horizontally-opposed engines developing 260 hp for take-off. The B-50 has a design gross weight of 6000 pounds and uses BEECHCRAFT Model 272-101 full-feathering propellers with aluminum blades which are driven through the nose reduction gears of the engine.

Designed primarily as a personnel transport, the B-50 is readily adaptable for use as a light cargo, ambulance, photographic or multi-engine training airplane.

## 1.2 GROUND HANDLING

Care must be used in ground handling of the airplane to avoid unnecessary damage. The following provisions and procedures are provided to reduce the possibility of ground damage.

### 1.2.1 Hoisting Provisions -

1.2.1.1 Hoisting Airplane - The aircraft may be hoisted for maintenance or parts replacement through the use of a three-cable sling attached to the hoisting lugs and eyebolt. A minimum overhead clearance of 12 feet 6 inches and a hoist of at least 3 tons capacity is required for hoisting.

NOTE

If it is necessary to hoist the aircraft with one or both engines removed, it will be necessary to use a sling under the tail. The tail mooring hole can be used to hold the sling in position.

1.2.1.2 Hoisting Engine - The engine may be hoisted by removing the propeller and cowling and attaching a hoist to the engine lifting eyes provided on top of the engine.

### 1.2.2 Jacking Provision -

Provision is made for a three point jack-pad system. The two aft pads are located on the center-section rear spar inboard of each nacelle. The forward jack pad is located near the aft edge of the nosewheel well and to the left of the fuselage center line.

Jack pads are provided on each main gear and nose gear so the wheels may be raised individually by use of an automobile-type jack for changing tires or minor brake repair.

### 1.2.3 Leveling Provisions -

Leveling the Twin-Bonanza while it is resting on its wheels is greatly simplified by its tricycle gear; it may be trimmed in both directions merely by inflating or deflating the main gear or nose gear struts, as required.

Lateral leveling is accomplished by using a bubble level on the rear baggage compartment floor board and deflating the tire or strut on the high side of the airplane to center the bubble.

To level the Twin-Bonanza longitudinally, attach a cord and plumb bob to the Phillips head screw just above the rear baggage compartment door. Inflate or deflate the nose gear shock strut as required, to pass the cord through the center of a second Phillips head screw directly below. Suspending the plumb bob in a can of light engine oil will assist in stabilizing it.

### 1.2.4 Anchoring and Mooring Provisions -

Three mooring eyes are provided, one on each wing and one in the tail bumper. Too moor the airplane, chock the wheels fore and aft, install control lock, and tie the airplane down at all three points. Avoid overtightening the rear rope and pulling the nose of the airplane up so far that wind will create lift on the wings. If extreme weather is anticipated, it is advisable to nose the airplane into the wind.

### 1.2.5 Parking Brake -

The brakes are locked in the "ON" position by pulling the parking-brake handle out and pumping the pilot's brake pedals until they hold a solid pressure.

NOTE

Do not attempt to lock the parking brake by applying force to the parking-brake handle. It controls a valve only and cannot apply pressure to the brake master cylinder.

### 1.2.6 Towing -

Towing lugs are provided on the nose strut and may be used for towing by hand or for towing with a jug. Turn limits are marked on the strut and must not be exceeded. Using the hand tow bar one man can tow the airplane on level concrete. When moving the airplane near other airplanes or buildings, it is advisable to have one or two helpers to aid in directing movement of the airplane to avoid damage to the wings or tail.

## 1.3 SERVICING INSTRUCTIONS

### 1.3.1 Servicing Fuel Tanks -

The airplane fuel system should be serviced with 80/87 octane fuel. The fuel system is suitable for use with aromatic fuels. Fuel-system access doors are of the flush type and are located on the upper surface of each outboard wing panel and each side of the wing center section between the nacelle and fuselage. Expanding-type filler caps with neoprene seals are used on each filler opening.

The fuel tanks are not interconnected and each

tank must be serviced separately. The inboard or center section tanks are the main tanks and should be filled first if a flight with reduced fuel load is to be made. The tanks are readily accessible for servicing over the leading edge of the wing.

NOTE

Since fuel will remove the plasticizer from the rubber cells, once the airplane is placed in service, the fuel cells should be refilled immediately after each flight. If extended periods of storage are required, the fuel cells should be drained, and the interiors coated with a thin coat of engine oil.

The fuel tanks may be drained by opening the drain cock located in the sump of each tank.

1.3.2 Servicing Oil System -

The engine is provided with a wet sump, pressure-type oil system with an oil cooler to aid in controlling oil operating temperatures. The sump capacity is 12 quarts maximum. Use Grade 1100 (SAE 50) and Grade 1065 (SAE 30) aviation oil in summer and winter respectively. The oil sump dip stick is calibrated for use in an airplane with either tricycle or conventional landing gear. Always check the oil level on the side of the dip stick marked "Tricycle".

To service the engine with oil, open the quick release oil access door on top of the cowling and remove the cap on top of the engine.

Oil may be drained by opening the cowling and removing the oil drain plug on the bottom of the engine oil reservoir and oil cooler. It is recommended that the engine be warmed up to operating temperatures to insure complete draining of the old oil.

1.3.3 Servicing Brakes -

The hydraulic brake system consists of two Goodyear single-disc brakes, which may be operated by either the pilot's or copilot's toe brakes on the rudder pedals. The brake fluid reservoir is located in the nose baggage compartment and should be filled to within one inch of the top with Specification MIL-O-5606 hydraulic fluid.

1.3.4 Servicing Tires -

The main wheel tires are 8:50 x 10, 6-ply, The nose wheel tire is a 6:50 x 10. Inflate all tires to 35 psi. Maintaining proper tire inflation will avoid considerable damage from landing shock and from running over sharp stones and ruts. When inflating tires, inspect them visually for cracks, breaks, or evidence of internal damage.

1.3.5 Servicing Landing Gear Shock Absorber -

The landing gear shock absorbers are of the air-oil type. They should be serviced with hydraulic fluid Specification MIL-O-5606.

To check the fluid level, deflate the strut by releasing air through valve; after the air pressure is released, remove the filler valve adapter.

NOMENCLATURE KEY

A - Main Landing Gear and Door
1. Main Landing Gear Door Linkage - 100 hours.
2. Main Landing Gear Lift Leg - 50 hours.
3. Main Wheel Bearings - 100 hours.

B - Aileron Control Quadrant
1. Aileron Control Quadrant - 200 hours.

C - Control Column
1. Control Column - 200 hours.

D - Empennage Control Surfaces
1. Rudder Tab Actuator - 200 hours.
2. Rudder Tab Linkage Universal Joints and Tab Hinge Wire - 100 hours.
3. Elevator Tab Linkage Universal Joints and Tab Hinge Wire - 100 hours.
4. Elevator Tab Actuator - 200 hours.

E - Aileron Tab Actuator
1. Aileron Tab Actuator - 200 hours.
2. Aileron Tab Cable Linkage - 100 hours.

F - Aileron Bell Crank
1. Aileron Bell Crank - 100 hours.

G - Carburetor Air Valve
1. Carburetor Air Valve - 100 hours. (Bulletin B50, No. 19 replaced these parts with sealed bearings which require no lubrication).

H - Tachometer Generator
1. Tachometer Generator - 50 Hours.

J - Propeller
1. Propeller and Transmission Gears - 100 hours.

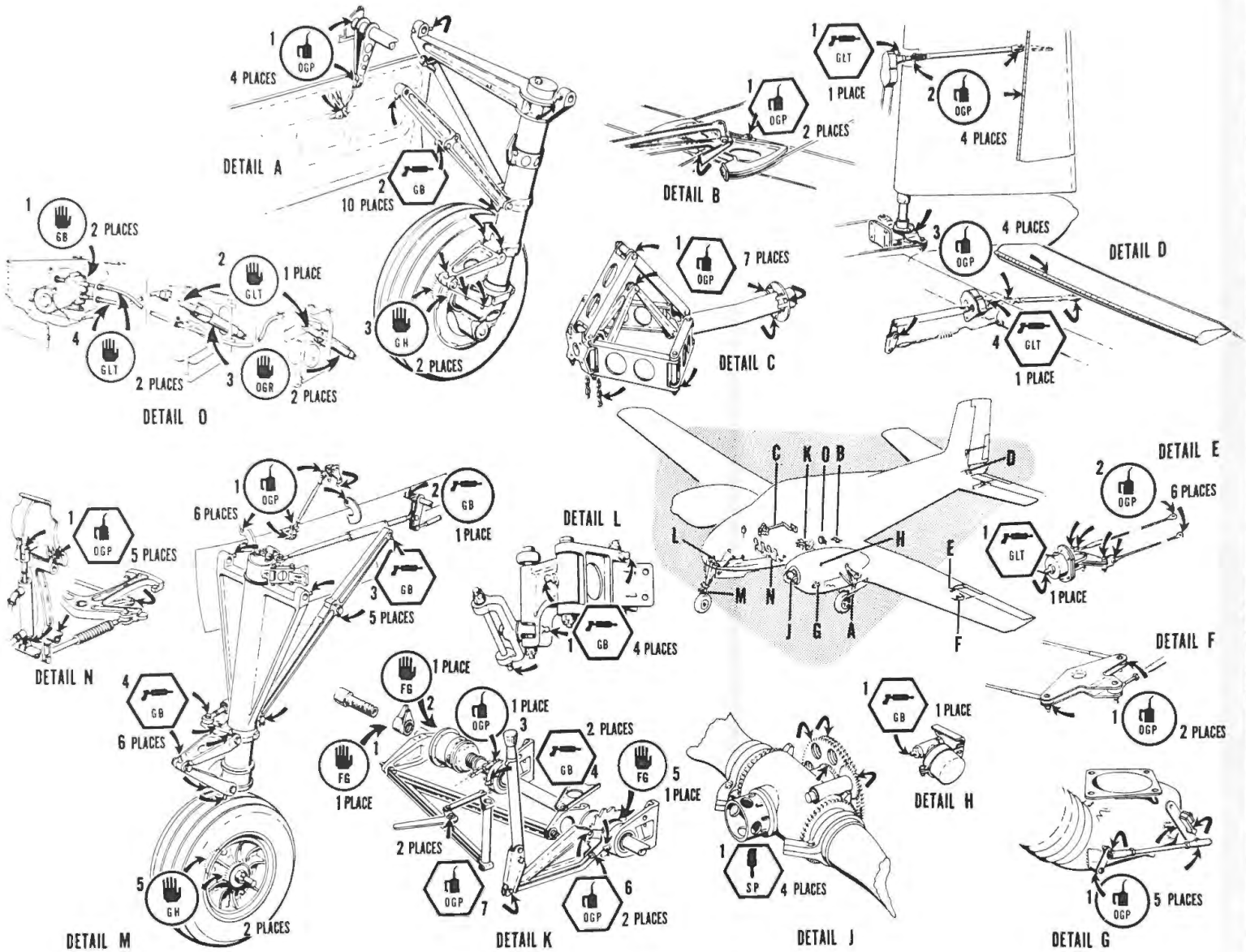
K - Landing Gear Retract Mechanism
1. Landing Gear Limit Switch Screw - 100 hours.
2. Landing Gear Clutch Finger - 100 hours.
3. Nose Gear Retract Chain - 100 hours.
4. Landing Gear Clutch Disengaging Bushing - 200 hours.
5. Landing Gear Clutch Fingers - 100 hours.
6. Landing Gear Emergency Extension Drive - 200 hours.
7. Landing Gear Emergency Handle Pin - 200 hours.
8. Landing Gear Gearbox - 500 to 1000 hours depending on operation.
9. Landing Gear Actuators - 500 to 1000 hours depending on operation.

L - Nose Wheel Steering Mechanism
1. Nose Wheel Steering Mechanism - 50 hours.

M - Nose Landing Gear and Door
1. Nose Gear Door Linkage and Hinges - 100 hours.
2. Nose Gear Steering Linkage Idler - 100 hours.
3. Nose Gear Lift Leg - 50 hours.
4. Nose Gear Torque Knees - 50 hours.
5. Nose Wheel Bearings - 100 hours.

N - Rudder Pedals
1. Rudder Pedals - 200 hours.

O - Flap Gearbox (Hours depend on type of operation)
1. Flap Gearbox - 500 to 1000 hours
2. Flap Actuator Drives - 500 to 1000 hours
3. Flap Actuators - 500 to 1000 hours
4. Flex Drive Shafts - 500 to 1000 hours




LEGEND

TYPE OF LUBRICANT

| IDENTIFYING SYMBOL | BASIC SPECIFICATION |
|---|---|
| SP | SPECIAL |
| GB Grease | MIL-L-7711 |
| FG Graphite | MIL-G-6711 |
| OGP Oil | MIL-L-7870 |
| OEA Oil | MIL-O-6082 |
| GLT Grease | MIL-G-3278 |
| GH Grease | MIL- L-3545 |
| OGR OIL | MIL-O-6086 |

FREQUENCY

HOURS — SPECIAL

METHOD

GREASE GUN — HAND OR PACK — OIL CAN — BRUSH

SPECIAL SERVICE NOTES

FITTINGS - Clean fittings before lubricating. Lubricate through fittings until new grease appears at the part being lubricated.

PIANO TYPE HINGES - Care should be taken to remove all excess lubricant after lubricating as it will accumulate dirt and sand and cause undue wear.

CONTROL SYSTEM BEARINGS - The ball bearings in this aircraft are sealed and do not require re-lubrication. Keep all control bearings wiped off and clean.

USE OF GRAPHITE - Mix powdered graphite with quick evaporating liquid (naptha) and apply with brush.

PROPELLER EXTERNAL GEARS - Use moly kote mixture; see PROPELLER MAINTENANCE, SECTION IV.

Figure 1-2. Lubrication Chart

(e) Install the mounting screws that secure the false panel to the aircraft structure.
(f) Install the plastic placard strip over switches and engine controls. Secure the fasteners by pushing into locking position.

## 5.6 INSTRUMENT VACUUM SYSTEM -

The vacuum system consists of two engine-driven vacuum pumps (one on each engine), an oil separator in each engine accessory section, a suction relief valve in each wheel well, a filter behind instrument panel, a suction gage on instrument panel, and necessary interconnecting tubing and hose. It powers the gyro-controlled flight instruments.

5.6.1 Adjustment of Suction Relief Valve -
(a) Loosen locknut and turn adjusting screw counterclockwise to increase suction, or clockwise to decrease suction.
(b) Adjust suction relief valve to draw 4.25 inches of mercury at cruising speed.

5.6.2 Removal of Vacuum Pump -
(a) Disconnect suction and discharge lines.
(b) Remove nuts from the four mounting studs.
(c) Pull pump out and off engine mounting pad.

NOTE

Before installation of pump, make sure lubrication holes in pump flange are not covered by the flange gasket.

5.6.3 Installation of Vacuum Pump -
(a) Place gasket in position on mounting studs.
(b) Place pump on engine mounting pad.
(c) Install and tighten nuts.

5.6.4 Removal of Oil Separator -
(a) Disconnect inlet, outlet, and oil return lines.
(b) Remove two bolts from mounting brackets.
(c) Lift unit from mounting.

NOTE

Clean oil separator in unleaded gasoline or other suitable solvent and dry thoroughly with compressed air each 100 hour inspection.

5.6.5 Installation of Oil Separator -
(a) Place unit in mounting bracket.
(b) Install bolts in mounting bracket and tighten.
(c) Connect inlet, outlet, and oil return lines.

5.6.6 Removal of Suction Relief Valve -
Disconnect lines at inlet and outlet elbows. Unit will fall free.

5.6.7 Installation of Suction Relief Valve -
Connect lines at inlet and outlet elbows.

5.6.8 Removal of Filter -
(a) Disconnect instrument lines at manifold.
(b) Remove nuts from the two mounting bolts.
(c) Remove filter bowl to clean or replace filter element.

NOTE

The filter should be cleaned every fifty hours. To clean element blow air through element in the direction opposite normal flow. Care should be taken not to blow air into element at right angles, as this will tend to clog dust in element. Tilt air hose at approximately forty-five degrees. After dust has been blown from element, wash in alcohol, then dry with compressed air.

5.6.9 Installation of Filter -
(a) Place unit on mounting bracket.
(b) Install nuts on the two mounting bolts.
(c) Connect instrument lines at manifold.

PART II
AIRFRAME

2.1 GENERAL

This section is devoted to the maintenance of the various components of the airframe group, including the fuselage, tail group, control surfaces and systems, wing sections and landing gear.

2.2 FUSELAGE

The fuselage is all-metal semimonocoque construction and is divided into the following sections: nose baggage compartment, pilot and passenger compartment, rear baggage compartment and fuselage tail section. Carry-through structure of the center-wing section passes through the lower section of the fuselage and is attached to the fuselage by shear connections that can be removed to detach the center section (see Figure 2-1).

2.2.1 Pilot and Passenger Compartment -

The cabin compartment is arranged to accommodate six persons, three in each seat. The front seat is arranged to accommodate the pilot on the left, an assist pilot in the center and one passenger on the right. The left two-thirds of the front seat is adjustable to fit the requirements of the pilot. The right third of front seat is hinged so that it will pivot forward on a skewed axis to permit access to the rear passenger seat. The control console is mounted in the instrument panel slightly to the left of center and contains the control column, engine control levers and aileron and rudder tab controls and position indicators.

2.2.2 Cabin Entrance Door -

Entrance to the cabin is made through a large door on the right-hand side of the fuselage. A wing walkway and an automatic, electrically-retracted step complete the entrance to the cabin. The door is of all-metal construction, the door skin spotwelded to the channel-type frame. The lever-type door handle and the hinges are flush-mounted so the door is completely flush with the fuselage skin when closed.

2.2.2.1 Removal -

(a) With the door in a nearly-closed position, press down on the portion of the stop rod that extends into the door until the stop rod can be removed from its track.

(b) Remove upholstery forward of door jamb to gain access to the door hinges.

(c) With one man supporting the door on the outside, remove the door hinge pins.

2.2.2.2 Minor Repairs and Parts Replacements -

(a) Replace worn or damaged door weather seal. The weather seal must fit smoothly around the entire door to prevent air leaks.

(b) Replace worn or damaged hinges or door latch.

(c) Repairs to the door skin may be made by approved methods for skin repairs.

2.2.2.3 Installation -

(a) Position door and align holes for the hinge pins.

(b) Install the hinge pins and safety.

(c) With the door in the nearly closed position, press the door stop rod down far enough to allow the end of the rod to enter the door stop track.

2.2.2.4 Adjustments -

Several adjustments are available to assure proper closing and sealing of the door.

(a) If the door does not close tightly or permits air leaks when completely closed (with door seals in good condition), it is probably due to insufficient tension on the aft door latch and may be corrected by loosening the four retaining screws and moving the latch tongue guide outboard to create additional tension on the latch tongue.

(b) Air leaks around the upper portion of the door may be caused by inadequate tension on the upper door latch. This may be corrected by removing the small upholstery panel above the door window and shortening the upper latch control wire sufficiently to properly seal the door.

(c) Sagging or improper fitting of the door may be corrected by adding thin shims under the lower hinge to raise the aft portion of the door.

2.2.3 Cabin Windows and Windshield -

The windows and windshield are formed of clear acrylic plastic and made up in seven removable sections. The rear windows are hinged at the top so they may be opened on the ground for additional cooling. The lower stop is readily removable so the rear window may be opened fully for emergency exit. A lock is provided on the lower stop to prevent the window being opened inadvertently in flight.

2.2.3.1 Removal -

(a) Remove sheet metal screws attaching the inner trim strip and remove the trim strip.

(b) With one man working inside and one outside remove the flush type machine screws retaining the frame.

(c) Remove window and frame. Care must be used when breaking window seals not to break or damage the plastic of the window.

2.2.3.2 Installation -

(a) Clean window frame and skin around window or windshield opening to assure satisfactory sealing of new window.

NOTE

New windows or windshield will require fitting which must be accomplished before applying cement.

(b) Apply thin coat of sealing cement, Minnesota Mining and Manufacturing Co., EC-870,

around the window opening.
(c) Install the window or windshield section and with one man inside the airplane, install the retaining screws and nuts. Tighten all the screws evenly to prevent excessive strain on the plastic.
(d) Clean excess sealer from the window and window frame with wooden scraper.
(e) Install the window or windshield trim strips.

2.2.3.3 Cleaning -
Cleaning of the acrylic plastic should never be attempted on dry windows. The window should first be flushed with water or a mild soap solution, then rubbed lightly with a grit-free soft cloth, chamois or sponge. Stubborn grease or oil deposits are readily removed with naphtha or hexane. Rinse with clear water.

2.2.4 Cabin Seats (Front) -
The front cabin seats are cushioned with foam rubber and internal springs. They are attached directly to the front spar of the center section. Built in two sections, the left two-thirds is adjustable fore and aft through approximately 3-1/2 inches of travel. The track is inclined so the seat moves upward as it is adjusted forward. The right-hand third of the seat swivels forward and to the left on a skewed axis to allow passenger access to the rear seat.

2.2.4.1 Removal -
(a) Remove the two hold-down bolts that attach the right-hand seat to the sidewall of the fuselage and center-section spar.
(b) Remove right-hand seat.
(c) Adjust the left-hand portion of the seat to the full forward position.
(d) Release the spring-loaded pin fasteners on each side of the seat adjustment casting.
(e) Release the quick-lock fasteners on the slide by turning the rings counterclockwise.
(f) Pull out on the rings and lift the forward portion of the seat up.
(g) Pull forward to remove the seat.

2.2.4.2 Installation -
(a) Place left-hand portion of seat in position and insert the aft end of the slide in the holes provided in the front spar. Align the holes in the front of the slide and lock the quick-lock fasteners.
(b) Pull out the spring lock on the seat adjustment attachment point, align with the adjustment casting and release to lock in position.
(c) Check adjustment for freedom of movement.
(d) Place right-hand seat in position and install attaching bolts at the fuselage sidewall and spar attaching bracket.

2.2.5 Cabin Seats (Rear) -

2.2.5.1 The rear cabin seats are constructed in two sections, cushioned with foam rubber and internal springs in the same manner as the front seats. The lower portion is attached to the rear center-section spar. The seat back may be tilted aft at the top.

2.2.5.2 Removal -
(a) Working from the baggage compartment, remove the bolt on each side which attaches the seat back adjustment to the fuselage.
(b) Working inside the cabin, release the trunk-latch type fasteners which attach the seat bottom to the front of the seat mounting structures.
(c) Pull the seat bottom forward to disengage the rear mounting pins.
(d) The seat then may be turned and the seat back folded down. Remove through the rear baggage compartment door.

2.2.5.3 Installation -
(a) Insert the rear attaching pins in holes in the seat mounting pads on the rear spar.
(b) Fasten the trunk latch fasteners which secure the front of the seat to the seat mounting structure.
(c) Install the bolts which attach the seat back adjustment to the fuselage structure.

2.2.5.4 Adjustment -
Pull the seat forward to release the latches and move back to the rearward position. To return the seat to the forward position, pull forward to the latches.

2.2.6 Nose Baggage Compartment -
The nose baggage compartment occupies the space immediately forward of the cabin. It provides 14 cubic feet of cargo space.

Access is through a door in the right side of the fuselage ahead of the wing. A dome light in the center of the compartment overhead is controlled by a micro switch in the door casing operated by the door latch. The starter control circuit also is routed through this switch. Opening the baggage door turns on the compartment light and breaks the starter relay control circuit, so that the engines cannot be started until the door is closed and latched.

2.2.7 Rear Baggage Compartment -
The rear baggage compartment, immediately aft of the cabin, contains 41 cubic feet of cargo space. The door is located in the right side of the fuselage, just aft of the wing. The compartment is lighted by a dome light controlled by a switch in the door casing.

2.2.8 Rear Fuselage Section -
The rear fuselage section is accessible by removing the rear bulkhead in the baggage compartment. It contains the tail surface control cables, turnbuckles and bellcranks. Access to the aft end may be gained by removing the tail cone and five inspection doors; two on each side below the horizontal stabilizer and one on the left side above the horizontal stabilizer.

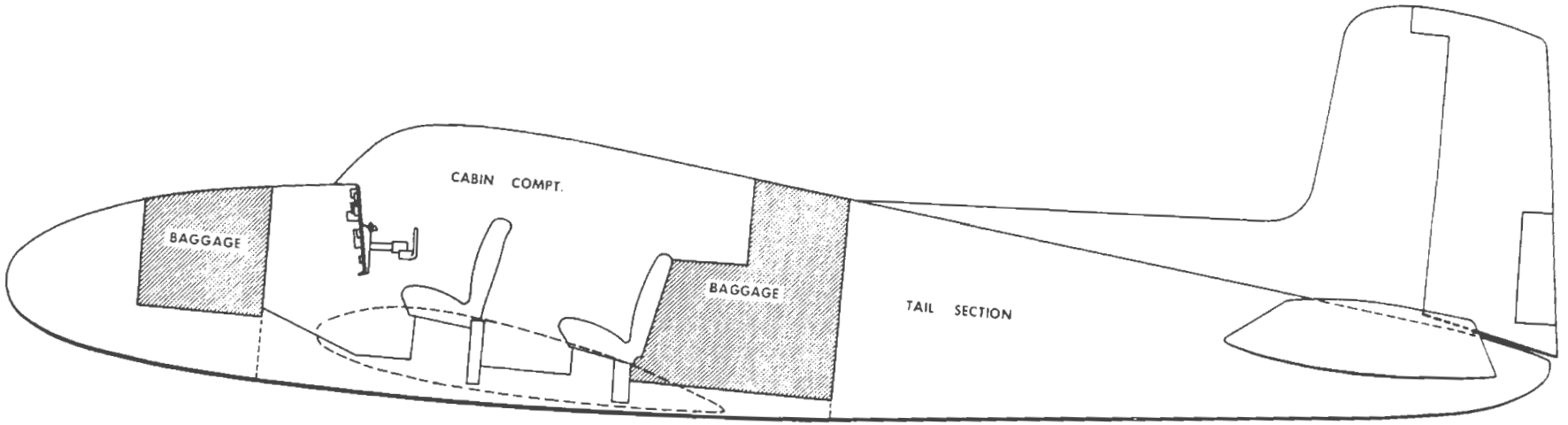



Figure 2-1. Compartment Diagram

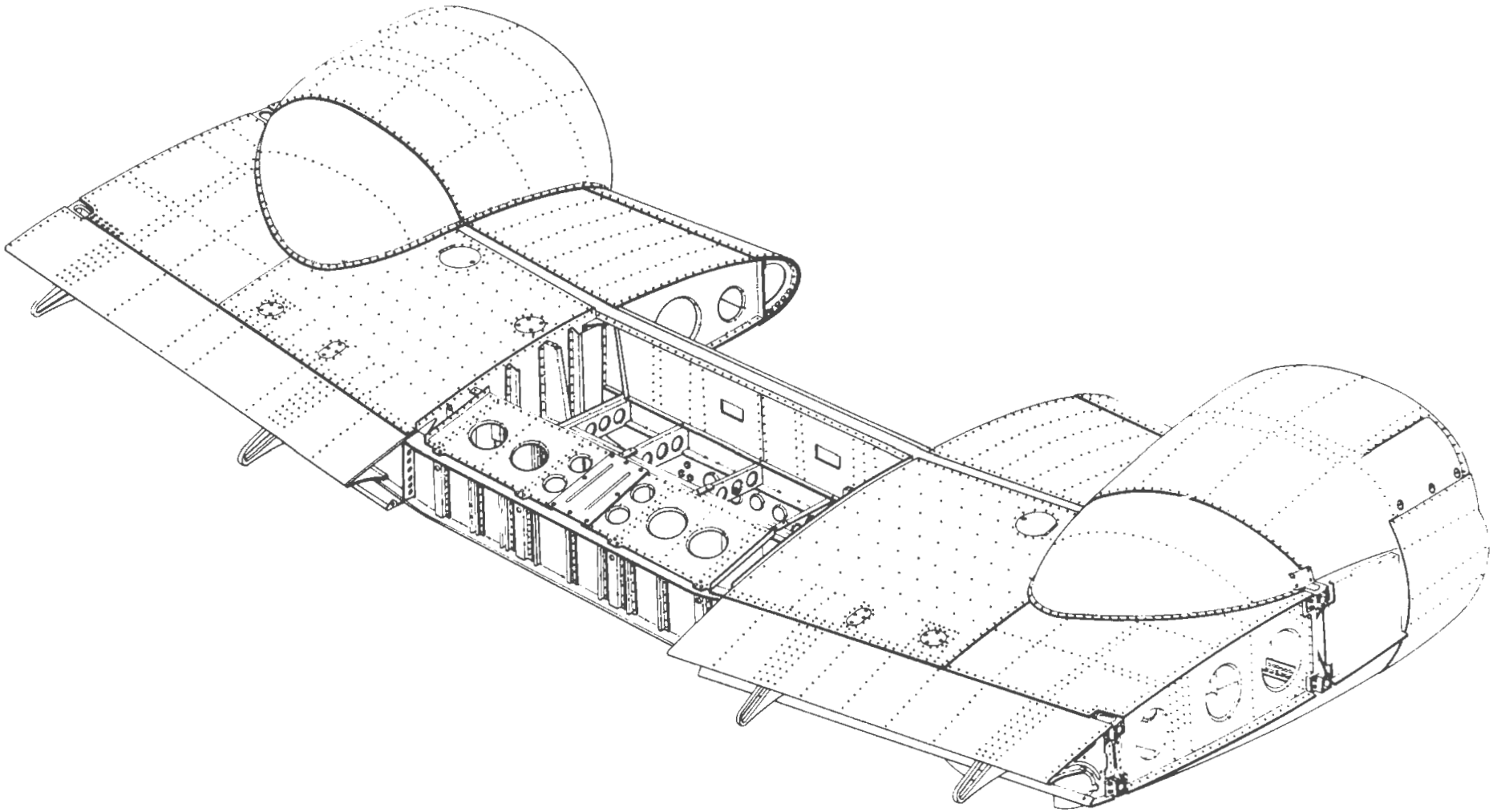


Figure 2-2. Center Section Wing

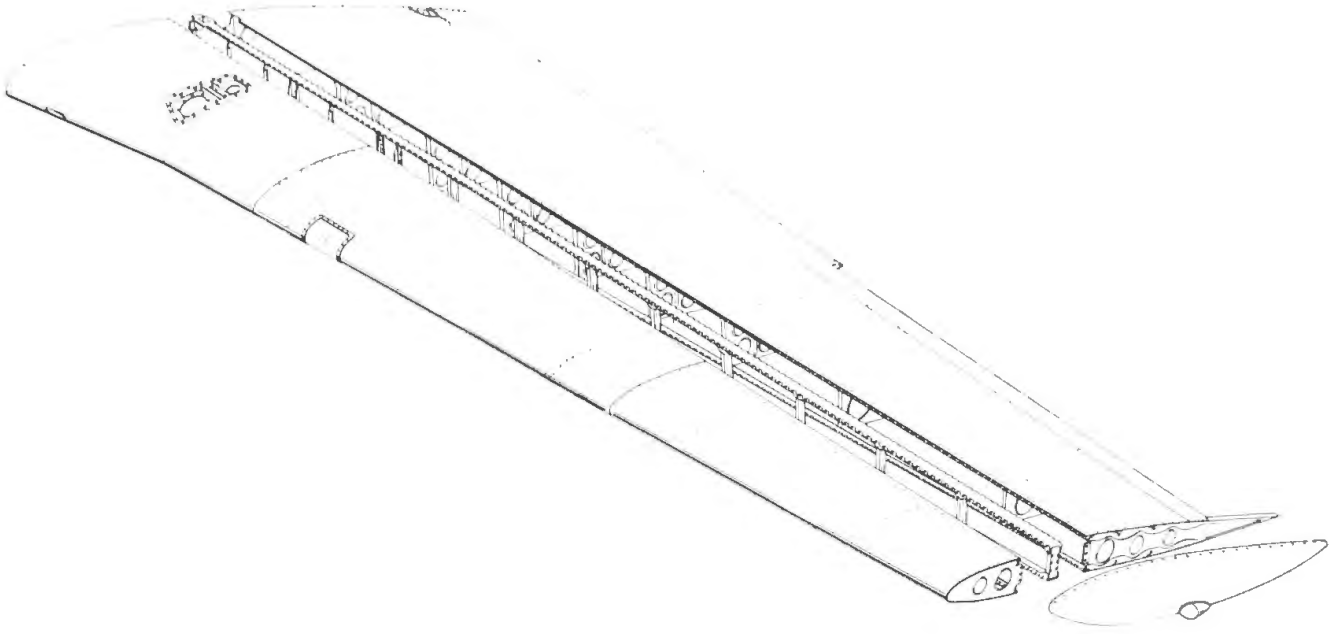


Figure 2-3. Outboard Wing Panel and Tip

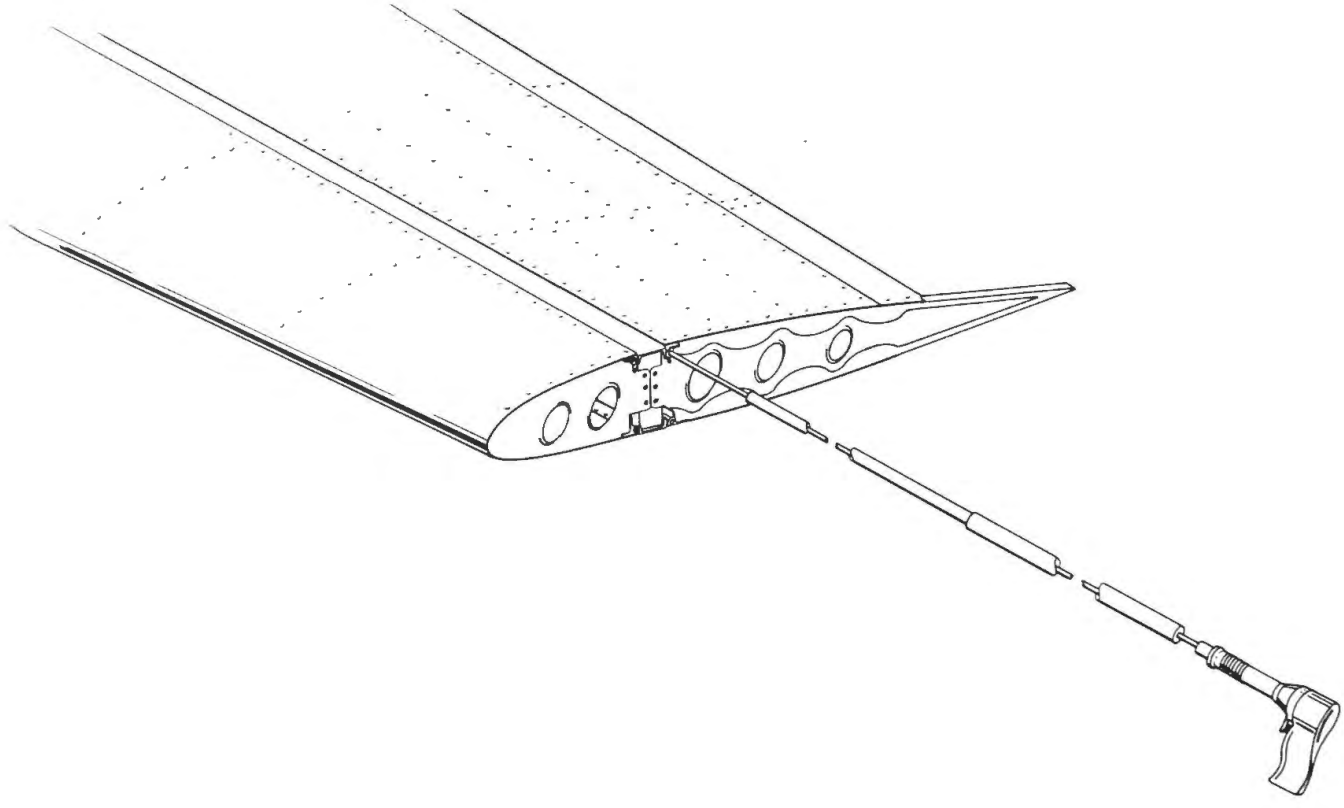


Figure 2-4. Wing Hinge Pin Installation

2.3 CENTER WING PANEL

The primary structure of the center wing section consists of the front and rear spar and a stressed skin covering. This structure forms a two-spar torsion box with the nacelle structure mounted on the front spar. The NACA 23000 series airfoil used on the outer wing panel is continued through the center panel. Bladder-type fuel tanks are located between the spars outboard of the fuselage.

2.4 ENGINE NACELLE

An integral part of the center wing panel, the engine nacelle, houses the engine, its mounting structure, and the landing gear. The portion of the nacelle from the firewall aft is attached by rivets and is not readily removable. Doors operated by the landing gear retract system and hinged to the lower side of the nacelle enclose the landing gear when it is retracted.

2.5 OUTER WING PANEL

The outer wing panels are NACA 23000 airfoils and are constructed with a single, load-carrying front spar and aluminum-alloy sheet skin covering. The rear spar or shear web transfers the shear load between the upper and lower skins. Attachment to the wing center section is made by four tension bolts located at the upper and lower caps of the front and rear spar. Outer wing bending loads are transmitted to the center section through tension on the bolts, or bearing of the faces of the outer wing and center section fittings on each other. The wing shear loads are carried by the serrated faces of the wing attachment points on a soft aluminum washer.

A bladder-type fuel cell is installed in the leading edge of each outer wing panel just outboard of the wing attachment fitting.

2.5.1 Removal of Wing -

(a) Drain fuel cell.

(b) Disconnect aileron and aileron tab cables (left wing only) at turnbuckles inside the wheel well.

(c) Remove augmenter tube cover plate and augmenter tube clamps. The augmenter tube is removed for access to fuel and fuel vent lines.

(d) Disconnect fuel lines, fuel vent lines and, on the left side only, the airspeed pitot line.

(e) Disconnect the navigation light, landing light and pitot heater wires at the electrical junction block inside the access hole on the lower side of the engine nacelle.

(f) Remove access hole cover on lower wing skin just forward of the rear spar at the wing attachment fitting. Disconnect the flexible flap drive.

(g) Remove the wing attaching bolt cover plates and attaching bolts.

NOTE

Special wrenches are required for the NAS high strength bolts used on the wing attachment fittings.

CAUTION

Be sure the wing is properly supported at the butt and tip before the wing bolts are removed. Move wing straight away from the airplane until all fuel lines are clear of the center section.

2.5.2 Disassembly -

(a) Support the wing on a suitable cradle.

(b) Remove wing tip.

(c) Remove screws attaching aileron to bracket, disconnect aileron tab cables (left aileron only). Remove aileron.

(d) Remove the bolt attaching the flap jackscrew to the flap. Remove the patch plates on top of the flap and remove the bolts attaching the flap to flap track.

(e) Remove access cover and scupper plate over fuel cell. Remove filler neck and fuel level transmitter. Unsnap the fuel cell from the upper skin. Disconnect the fuel outlet and vent lines. Remove the fuel cell through the access hole.

(f) Remove the screws around the spar cap and rib at the wing attaching point and the screws at the tip rib.

(g) The steel retaining wire may be removed by grasping with pliers and pulling. (Vise grip pliers are recommended.) Remove the wires retaining the leading edge first, then remove the wires holding the spar to the rear wing section. Do not attempt to spin the wires out with a drill motor; the heating and expansion of the wire will cause it to seize in the hinge and break.

2.5.3 Reassembly -

(a) Before assembling the spar to the wing sections, it is advisable to drive a retaining wire through the hinge sections to remove any burrs or foreign matter.

(b) Use a new retaining wire and coat liberally with paraffin or powdered graphite.

(c) Assemble the spar to the rear wing section and align the hinge sections.

(d) Using an E-2 rivet gun (or gun of equivalent size) drive the wire in. The wire must be supported during the driving operation and the use of the following sizes of telescoping tubes are recommended: 3/16 x .049 steel tubing - 60, 32, 17, 9, 5, 2-1/2 in.; 1/4 x .049 steel tubing - 60, 32, 17, 9, 5, 2-1/2 in. The retaining wire is inserted in the assembled steel tubing guides and as the wire is driven in, sections of the tubing are removed.

CAUTION

Do not use a drill motor to spin the wire in as the heat and expansion may cause the wire to seize and break.

(e) Install the leading edge in the same manner as the rear wing section.

(f) Replace machine screws around the spar fittings and tip and butt rib.

2.5.4 Repair -

The wing is entirely stressed skin construction. Any repair to the skin or internal structure should be made by a BEECHCRAFT Certified Service Station, or by a facility properly equipped to accomplish structural repair.

2.5.5 Installation -

(a) Place wing in position for installation and install the wing attaching bolts.

WARNING

New aluminum washers must be installed between the upper center section and outer wing panel fitting each time the wing bolts are loosened enough to allow the serrated faces of the upper wing attaching fittings to change position in relation to each other.

(b) Tighten the wing attaching bolts to the following torque:

1 Lower forward spar bolt, 5,000 to 5,500 inch-pounds.

2 Upper forward, upper and lower rear spar bolt, 2,000 to 2,300 inch-pounds.

(c) Connect electrical wiring at junction block in lower side of engine nacelle.

(d) Connect fuel outlet and fuel vent line, and pitot line (left wing only).

(e) Connect aileron and (left wing only) aileron tab cable turnbuckles in landing gear wheel well. Rig to proper tension.

(f) Connect the flap flexible drive.

(g) Check flap travel and stops. Check operation of navigation lights, landing lights, and pitot heat. Fill the fuel tank and check for leaks. Check the airspeed system for proper operation, preferably against a master instrument. When using a master instrument for checking the airspeed the temperature must remain constant and differential must not exceed five mph in 15 minutes.

(h) Install augmenter tubes and all access hole covers.

NOTE

Retorque the wing bolts as indicated in Paragraph 2.5.5 after first 100 hours of flight time after wings are installed.

2.5.6 Adjustments -

Rigging adjustment of the wing is not ordinarily necessary; however, when flight tests indicate a wing-heavy condition, the wing may be washed in or out for correction. Proceed as follows:

(a) Mark the present position of the wing on the wing attachment fittings.

(b) Loosen the wing attaching bolts.

(c) Remove the bolts one by one and replace the soft aluminum washers between the wing attachment fittings.

(d) Determine the new position of the wing and tighten the wing bolts.

NOTE

If wing is heavy, the leading edge must be raised above its original position, as indicated by the marks made before loosening the bolts. If wing is light the leading edge should be lowered.

(e) Test fly aircraft. Readjust if necessary.

NOTE

New soft aluminum washers must be installed when the wings are rotated and a log book entry made so the wings may be retorqued after the first 100 hours of flight time after the washers are installed. The stall warning indicator also must be checked and the detector vane reset if necessary.

2.6 WING TIP

The wing tip is formed of soft aluminum and is readily removable for repair.

2.6.1 Removal -

(a) Remove the machine screws attaching the wing tip to the wing.

(b) Unscrew the electrical lead to the navigation light from the navigation light base.

2.6.2 Installation -

(a) Attach the electrical lead to the navigation light base and tighten.

(b) Install machine screws which attach the wing tip to the wing.

2.7 CONTROL SURFACES

NOTE

All control surfaces, both fixed and movable, are of stressed-skin construction. Therefore, all repairs must be made by a BEECHCRAFT Certified Service Station or other facility properly staffed and equipped for structural repairs.

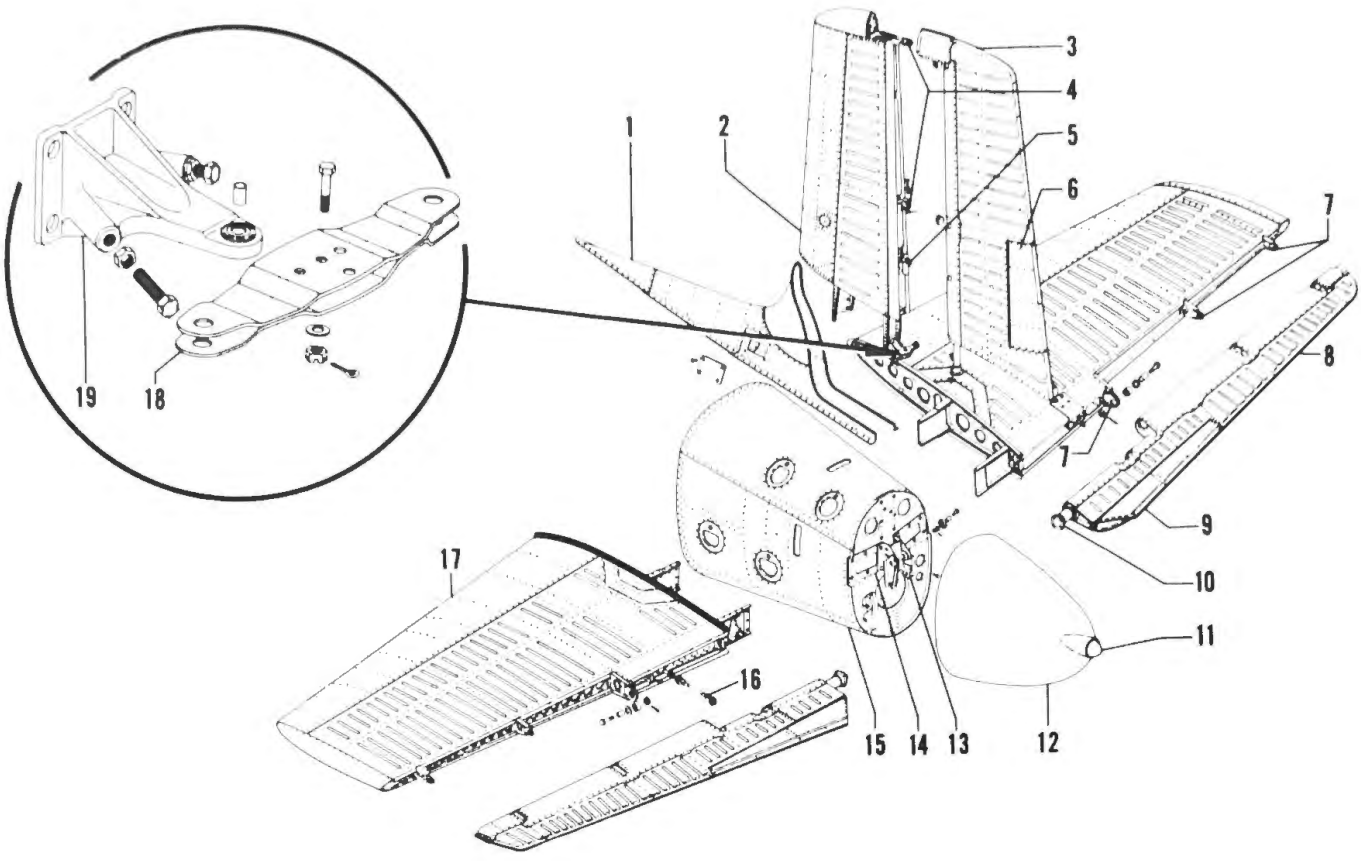
2.7.1 Horizontal Stabilizer -

The horizontal stabilizer is of all-metal construction with two channel section main spars. The metal skin utilizes internal bead stiffeners. The stabilizer is attached to the fuselage by bolted shear connections at the front and rear spar.

2.7.1.1 Removal -

(a) Remove the elevator tab actuating arm at the tab.

(b) Remove the plastic tail cone.




1. Dorsal Fin
2. Vertical Stabilizer
3. Rudder
4. Rudder Hinge
5. Rudder Trim Tab Actuator
6. Rudder Trim Tab
7. Elevator Hinges
8. Elevator
9. Elevator Trim Tab
10. Elevator Torque Arm
11. Tail Light
12. Tail Cone
13. Elevator Actuator
14. Horizontal Stabilizer Fitting
15. Rear Fuselage Assembly
16. Elevator Trim Tab Actuator
17. Horizontal Stabilizer
18. Rudder Bell Crank
19. Rudder Bell Crank Bracket

Figure 2-5. Empennage Section

(c) Remove the elevator (see Paragraph 2.7.4.1).
(d) Remove the rear fuselage access cover and disconnect the elevator tab cables at the turnbuckles. Remove the tab cable pulleys on aft fuselage bulkhead.
(e) Remove tail section hand hole covers above and below stabilizer to gain access to the stabilizer attaching bolts.
(f) Remove the shear bolts attaching the front and rear stabilizer spars.
(g) Pull stabilizer directly away from the airplane until completely clear.

2.7.1.2 Installation -
(a) Position stabilizer for installation and align bolt holes.
(b) Install mounting bolts and tighten.
(c) Route tab cables back through the fuselage. Connect turnbuckles and install pulleys.
(d) Install the elevator (see Paragraph 2 7.4.2).
(e) Check the rig and operation of the trim tabs (see Paragraph 2.8.4.4).

2.7.2 Vertical Stabilizer -
The vertical stabilizer is of all-metal construction with two channel section main spars. The metal skin utilizes internal bead stiffeners. The stabilizer is attached to the fuselage by bolted shear connections at the front and rear spar.

2.7.2.1 Removal -
(a) Remove the rudder as outlined in Paragraph 2.7.5.1.
(b) Remove the access plates on the left side of the fuselage above the horizontal stabilizer.
(c) Disconnect tab cables.
(d) Remove the bolts attaching the vertical fin to the rear fuselage bulkhead.
(e) Remove the attaching bolts at the forward fin attachment point.

2.7.2.2 Installation -
(a) Install bolts at front and rear attachment points.
(b) Connect tab cables.
(c) Install the rudder as outlined in Paragraph 2.7.5.2.
(d) Install the tail cone and access plates.

2.7.3 Aileron -
The aileron is constructed primarily of FS-1a magnesium alloy sheet. Other materials are used locally for reinforcement of hinge brackets, balance weight supports and other stressed structural parts. Each aileron has a single channel-section spar of FS-1a magnesium alloy. The skin is formed in one piece and beaded chordwise for reinforcement.

2.7.3.1 Removal -
(a) Disconnect the trim tab cables (left aileron only).
(b) With one man supporting the aileron, remove the attaching screws at each aileron hinge bracket.
(c) Move the aileron straight away from the bracket until completely clear. Care must be used to avoid damage to the skin by causing binding or strain in attaching area.

2.7.3.2 Installation -
(a) Place aileron in position on the hinge brackets. Be sure that the hinge bracket is in its proper place between the aileron skin and the inner reinforcing structure.
(b) Install two upper and two lower attaching screws at each aileron hinge bracket.
(c) Connect aileron tab cables (left aileron only). Check operation of the aileron tab to be sure it is operating in the direction indicated by the control and the cables are not crossed.

2.7.4 Elevator -
The elevator is built principally of FS-1a magnesium alloy, with a few stressed parts of 24ST aluminum and mild steel. The skin, spar, small ribs and most detail parts are magnesium alloy. The three main ribs and balance horn are 24ST aluminum. The hinge brackets are mild steel. The skin aft of the spar is beaded for reinforcement.

2.7.4.1 Removal -
(a) Remove tail cone attaching screws, disconnect tail navigation light wire and remove tail cone.
(b) Disconnect the tab actuator rod.
(c) Remove the four bolts attaching the elevator extension tube adapter to the elevator horn.
(d) Remove the hinge bolts, disconnect the bonding cable and pull the elevator away from the stabilizer.

2.7.4.2 Installation -
(a) Align holes in elevator and stabilizer hinge, install attaching bolts and connect the bonding cable.
(b) Install bolts which attach the extension tube adapter to the elevator horn.
(c) Attach elevator tab actuator.

2.7.5 Rudder -
The rudder is built principally of FS-1a magnesium alloy, with a few stressed parts of 24ST aluminum or mild steel. The skin, spar, small ribs and most detail parts are magnesium alloy. The three main ribs and balance horn are 24ST aluminum. The hinge brackets are mild steel. The skin aft of the spar is beaded for reinforcement.

2.7.5.1 Removal -
(a) Remove tail cone attaching screws and disconnect rear navigation light wire. Remove the tail cone.
(b) Disconnect rudder tab actuating rod aft of the actuator.
(c) Remove the attaching bolts at rudder horn.
(d) Remove rudder attaching bolts from the rudder hinge and remove rudder.

2.7.5.2 Installation -
(a) Align holes in rudder and stabilizer hinge and install attaching bolts.
(b) Install lower attaching bolts through rudder horn.
(c) Connect rudder tab. Check travel of tab and rudder tab indicator to see that tab and indicator agree.

2.7.6 Wing Flaps -
The wing flaps are of aluminum alloy with magnesium alloy stressed skin. Two flaps, inboard and outboard, are attached to each wing. They are hinged to specially-designed tracks and electrically operated. Full travel is 30 degrees, with a take-off setting of 20 degrees.

2.7.6.1 Removal of Flaps -
The following procedure applies to both inboard and outboard flaps:
(a) Remove bolt from flap actuating arm.
(b) Remove bonding from flap tracks.
(c) Remove bolts from flap track brackets and remove flaps.

2.7.6.2 Installation of Flaps -
(a) Hold flap in position and install bolts in flap track bracket.
(b) Bond flaps to flap tracks.
(c) Install bolt in actuating arm.

2.8 SURFACE CONTROL SYSTEMS
The control surfaces are actuated by cables attached to controls of conventional pattern. Tension on the cables should be maintained within the limits given in the following table for proper operation:

| | |
|---|---|
| Aileron Cables (3/16) | 50 + 5, -0 lb |
| Aileron Cables (1/8) | 30 + 5, -0 lb |
| Elevator | 45 + 4, -4 lb |
| Rudder | 36 + 5, -0 lb |
| Aft Elevator Tab | 5 + 2, -0 lb |
| Aileron Tab | 10 + 3, -2 lb |
| Rudder Tab | 10 + 3, -2 lb |

2.8.1 Aileron Control System -
The aileron control system consists of a wheel connected through a chain and sprocket to a torque tube through the elevator control shaft then to cables routed aft under the floorboard to a control quadrant under the rear seat, forward of the rear spar. From this quadrant, cables run outboard to a combination bellcrank and push-pull rod in the wing.

2.8.1.1 Removal -
Access for removal of the aileron cable from the control wheel aft to the control quadrant is made by removing the cabin floorboards. Cables through the wing are accessible through the wheel well and through inspection plates on the lower side of the wing. When removing a cable, pull a wire or heavy cord through with the old cable as it is removed, to facilitate installation of the new cable.

2.8.1.2 Minor Repair and Parts Replacement -
Cables that are rusted, corroded or frayed are not considered serviceable and must be replaced.

2.8.1.3 Installation -
To install a cable, attach the new cable to the wire pulled through with the old cable and pull the new cable through. Attach cable ends to the control, reinstall the pulleys. Rig the system as indicated in Paragraph 2.8.1.4.

2.8.1.4 Rigging of the aileron control system is accomplished by installing the control surface lock to hold the control wheel and shaft in neutral. The aileron quadrant forward of the rear spar, is locked in neutral by inserting a rigging pin through the quadrant. Rig the 1/8-inch cables in the fuselage to 30 pounds, plus 5 pounds, minus 0 pounds. With the aileron in neutral, rig the outer cable turnbuckles to the nacelle to a cable tension of 50 pounds, plus 5 pounds, minus 0 pounds. The correct aileron travel is 20 degrees up and 20 degrees down. Fixed stops are provided in the control column and adjustable stops are provided on the bellcrank in the wing.

2.8.2 Aileron Tab System -
The movable aileron tab is installed on the left aileron only with a fixed tab on each aileron, and is controlled by a knob on the control console. A visual aileron tab position indicator is connected into the control system and mounted on the console. The tab control system consists of the control knob which is connected to a cable drum to drive 1/16-inch flexible cables routed under the floor to pulleys on the rear spar, then to an aileron tab jackscrew mechanism at the inboard end of the left aileron. Cables of the same size pass from the jackscrew through the rear wing section to the aileron tab horns.

2.8.2.1 Removal of the aileron tab cables is accomplished by removing the seats and floorboards and removing pulleys and pulley guards to allow the cable terminal to pass through. Outboard sections of the cable are accessible through the wheel well and access holes in the lower wing skin. When removing a control cable, pull a wire or heavy cord through with the old cable to facilitate installation of the new cable.

2.8.2.2 Minor Repairs and Parts Replacement -
Cables that are rusted, corroded or frayed are considered unserviceable and must be replaced.

2.8.2.3 Installation of aileron tab cables may be made by attaching wire drawn through with the old cable to the new cable and pulling the new cable through. Attach cable to controls and install pulleys. Rig the cable to tension and check as outlined in Paragraph 2.8.2.4.

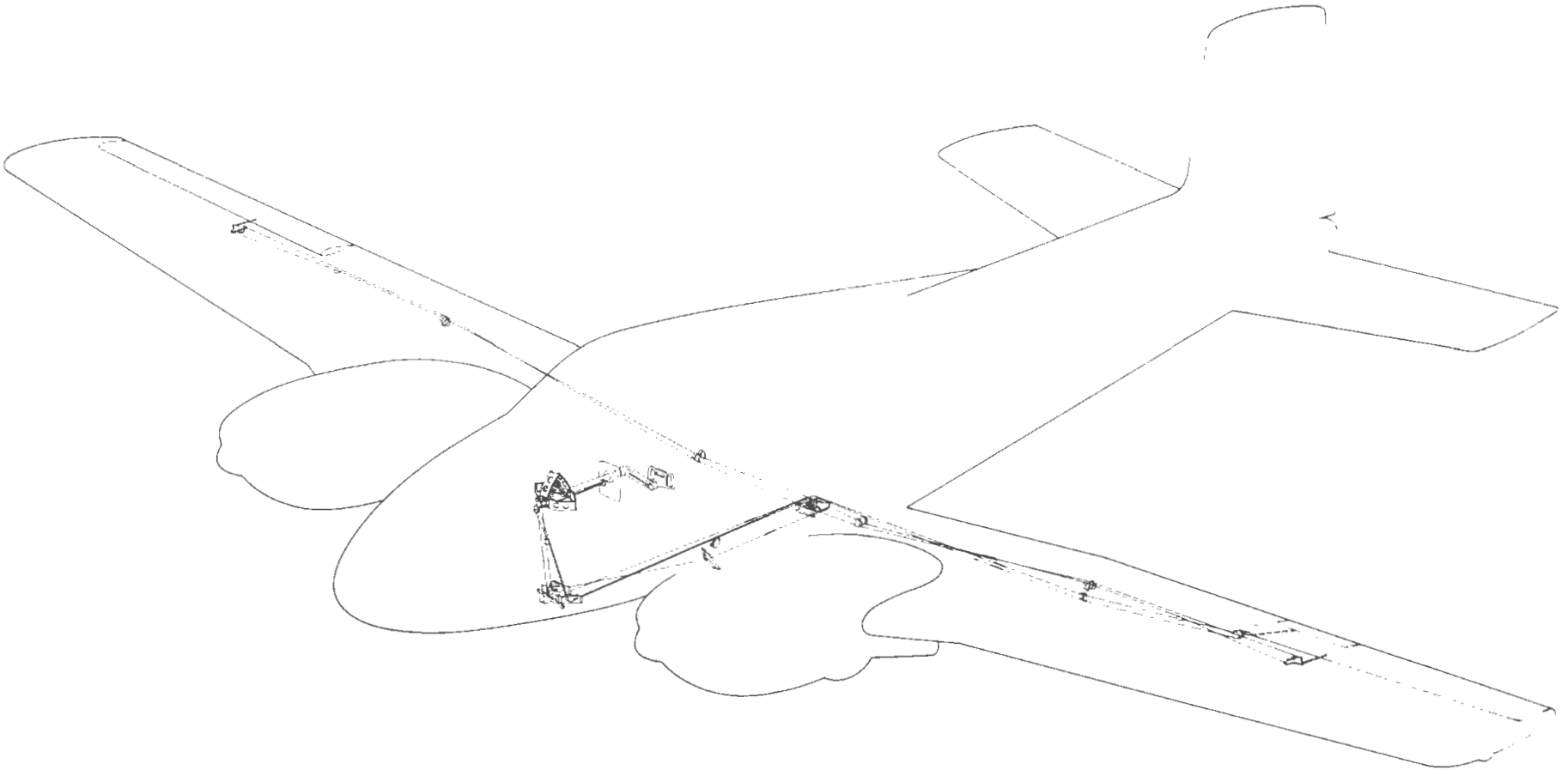


Figure 2-6. Aileron Control System

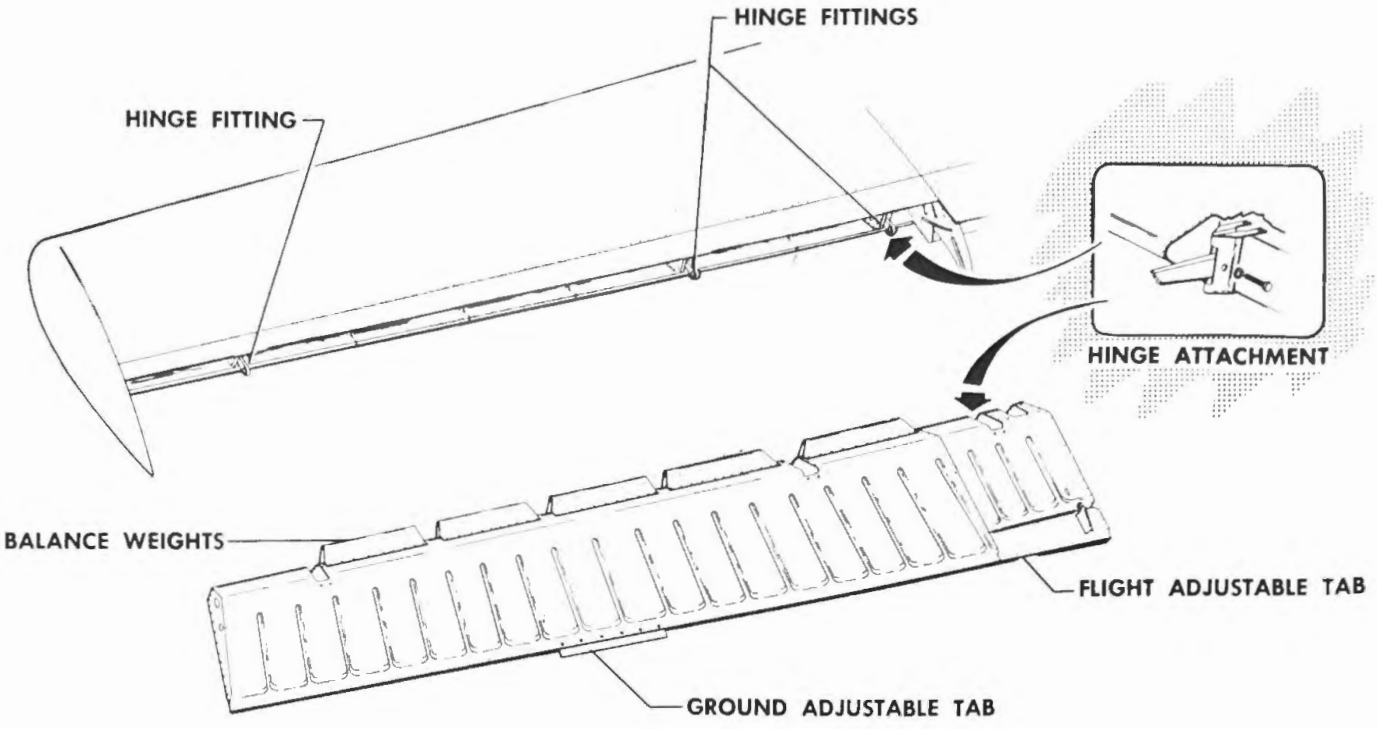



Figure 2-7. Aileron Assembly

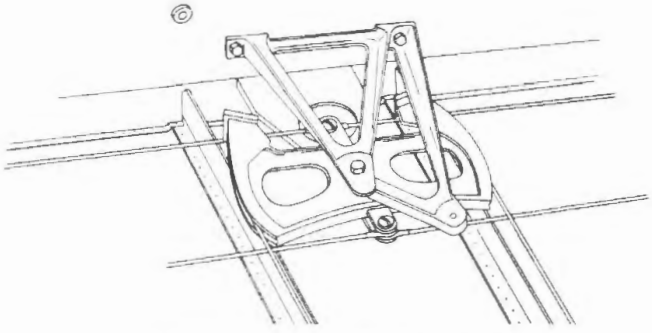


Figure 2-8. Aileron Quadrant

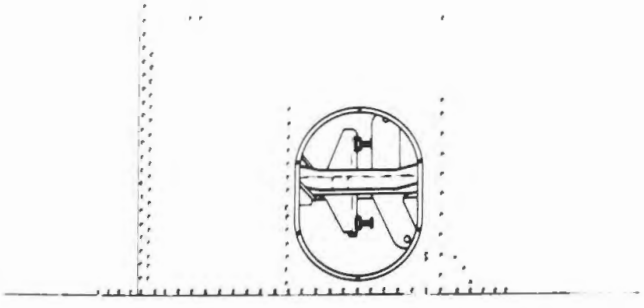


Figure 2-9. Aileron Stops in Wing

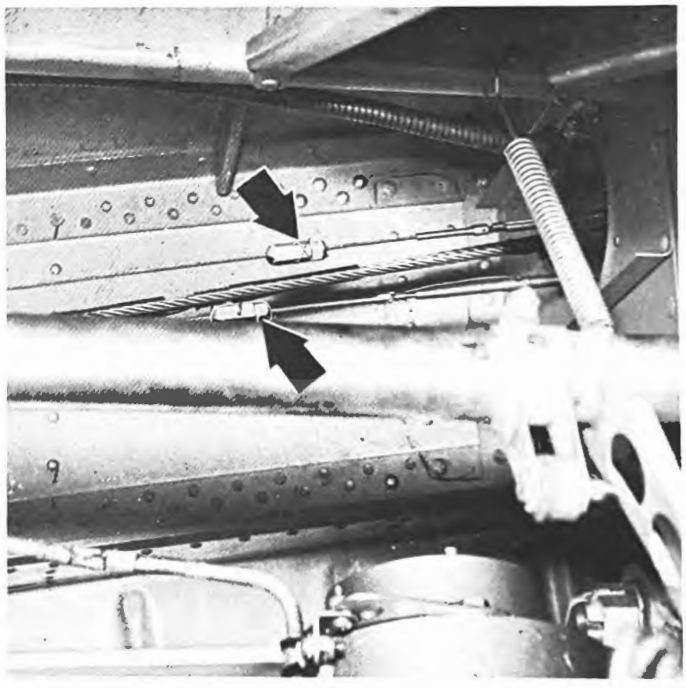


Figure 2-10. Aileron Tab Stops in Nacelle

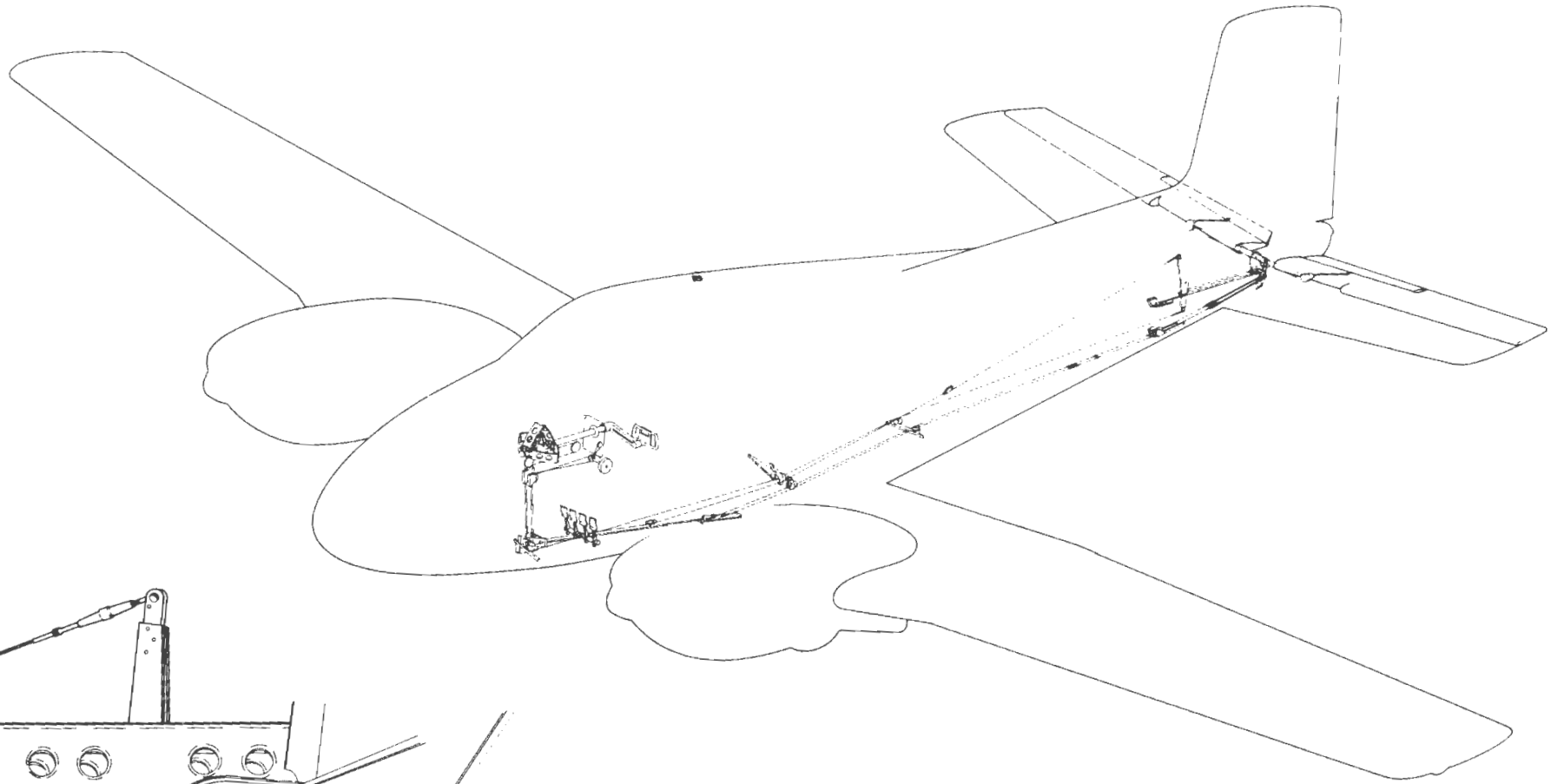


Figure 2-11. Elevator Control System

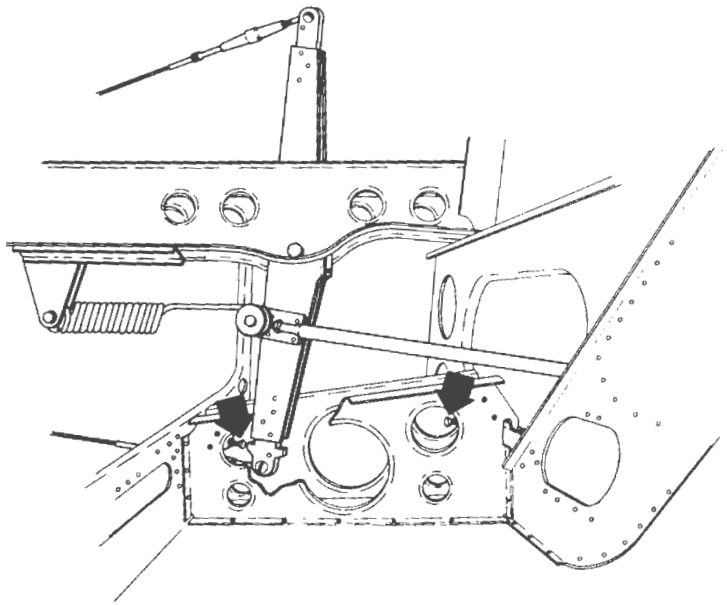


Figure 2-12. Elevator Bell Crank Stops

2.8.2.4 Rigging -

To rig the tab cable set the tab indicator on the control console to the zero reading. Adjust the jackscrew mechanism in the wing to a neutral setting. Rig the forward portion of the tab cable to a tension of 10 pounds plus 3 pounds, minus 2 pounds. Rig the cables from the jackscrew to the tab horn so the tab is in neutral and rig the cable tension to 10 pounds plus 3 pounds, minus 2 pounds. The aileron tab travel is 20 degrees up and 20 degrees down. Limit stops are provided on the tab cable in the wheel well to stop the tab at extreme ends of its travel. The limit stops may be adjusted by loosening the jam nut on the stop and setting the tab in the proper position, then sliding the limit stop down the cable until it strikes the inboard bulkhead of the wheel well. Then set the aileron tab in the opposite position and adjust the other cable stop.

2.8.3 Elevator Control System -

The elevator control system consists of the wheel-type push-pull control column connected to 1/8-inch control cables routed under the floor board to a bellcrank in the fuselage tail section. Push rods connect the bellcrank to the elevator horn to complete the primary elevator control system. An assist spring attaches to the bellcrank in the fuselage tail section and helps relieve the control forces and provide added longitudinal stability.

2.8.3.1 Removal -

Access to the elevator control system is made by removing the cabin floor boards and rear baggage compartment bulkhead. Cable attachments at the bellcrank may be reached by removing the access plates under the horizontal stabilizer. Remove the elevator pulleys and pulley guards. Attach a wire or cord to the old cable when removing it to facilitate installation of the new cable.

2.8.3.2 Minor Repair and Parts Replacement -

Rusted, corroded, or frayed cables are considered unserviceable and must be replaced.

2.8.3.3 Installation -

Attach the new cable to the wire pulled through with the old cable and pull the new cable through. Connect the new cable to the control column and bellcrank. Install the pulleys and pulley brackets. Rig the cable as indicated in Paragraph 2.8.3.4.

2.8.3.4 Rigging -

Rigging instructions are included for the entire elevator system; however, ordinarily it will not be necessary to disturb the rig of all sections of the system for routine maintenance operations or cable replacement. To rig the system, release cable tension by loosening the turnbuckles at the bellcrank in the rear fuselage section. Set the bellcrank in neutral (vertical) position and adjust the push rod as required to bring the elevator to a neutral position. To rig the cables, move the control column forward until it strikes the control column stop, then move the column back off the stop four inches; with the column in this position and the elevator in neutral, rig the cables to tension . A parallel clamp or padded "C" clamp may be clamped on the control column shaft to hold the rigging position. The elevator cables are rigged to a tension of 45 plus 4 minus 4 pounds. Adjustable elevator stops are provided on the bellcrank in the fuselage tail section and are accessible through inspection openings underneath the horizontal stabilizer. The elevator travel is 25 plus or minus 1 degree up and 15 plus or minus 1 degree down.

2.8.3.5 Elevator Assist Spring Tension -

Correct tension on the elevator assist spring is 30 pounds, plus 0, minus 3 pounds. The tension is to be checked by attaching a spring scale to the control wheel and taking the reading with the column 1/8 inch off its rear travel stops. The spring tension is not adjustable, and weak springs should be replaced. If excessive tension is indicated, before condeming the spring check the control column, cable pulleys, and the elevator bellcrank and hinges for freedom of movement and proper lubrication.

2.8.4 Elevator Tab System -

The elevator tab system consists of a control wheel mounted below the instrument panel which drives a cable drum and actuates a tab position indicator on the pilot's control console. From the cable drum 1/16-inch cables are routed under the floorboards to turnbuckles in the fuselage tail section. At this point, two cables are attached to each of the forward cables and routed aft through the fuselage and outboard through the stabilizers to the elevator tab actuators. Actuator rods are connected to the tab horns to complete the tab control system.

2.8.4.1 Removal -

Access to the trim tab cables and pulleys for removal is made by removing the cabin floorboards, and the inspection doors on rear fuselage under the stabilizer. Access to the tab cables aft of the rear fuselage bulkhead is made by removing the tail cone. To remove cable, disconnect turnbuckles and attach wire or cord to be drawn through with the old cable. Remove pulleys and pulley guards to allow turnbuckle ends to pass through. Pull old cable out, drawing guide wire into place.

2.8.4.2 Minor Repair and Parts Replacement -

Control cables which are rusted, corroded or frayed will be considered unserviceable and must be replaced.

2.8.4.3 Installation of the rear elevator tab cable is accomplished by attaching one end to the guide wire drawn in with the old cable and pulling the new cable through. Use the following procedure to install the forward cable:

(a) Unsolder the copper cable connecting the control wheel drum with the position indicator and remove wheel.

(b) Beginning with the exact center of the new cable, wrap two turns of each bight of the cable around the drum, in the opposite direction from each other.

NOTE

After winding cable on drum, recheck to be sure the two ends are exactly the same length.

(c) Install wheel and reconnect copper indicator cable, soldering the ends.

(d) Attach the ends of the control cable to the wire drawn in with the old cable and pull the new cable through.

(e) Replace stop and turnbuckle.

2.8.4.4 Rigging Elevator Tab -
(a) Disconnect tab at actuator horn.
(b) Set control wheel so forward cables are of equal length. (Turnbuckles opposite each other.)
(c) Adjust position indicator to 10.5 degrees NOSE UP with turnbuckles opposite.
(d) Connect forward and rear cables, making sure turnbuckles on rear cables are opposite each other
(e) Rig aft cable tension to 5 pounds, plus 2, minus 0 pounds.
(f) Turn control wheel so indicator reads 0 degrees. Cable turnbuckles will not be opposite.
(g) Adjust actuator linkage to place tab in neutral and connect.
(h) Adjust tab stops for 10 degrees, plus or minus 1 degree up travel and 21 degrees, plus or minus 1 degree down travel.

2.8.5 Rudder Control System -
The rudder control system consists of the pilot and copilot's rudder pedals, a rudder pedal quadrant and aligning rod. The 3/16-inch cables are routed aft under the floorboard to the rudder bellcrank. The rudder pedals are readily adjustable fore and aft to fit the requirements of the individual pilot.

2.8.5.1 Removal -
To remove the rudder cables, remove the fuselage tail cone, the tail section access panel in the rear baggage compartment and the cabin floorboards. To remove the cable, remove attaching bolts at the rudder bellcrank and rudder pedals. Remove the pulleys and pulley guards so the cable terminals will pass through. Attach a guide wire or cord to the cable to be removed. Pull the old cable out, drawing the guide into place.

2.8.5.2 Minor Repair or Parts Replacement.-
Cables that are rusted, corroded or frayed will be considered unserviceable and must be replaced.

2.8.5.3 Installation -
To install the rudder cable, attach it to the end of the guide wire that was drawn in when the old cable was removed. Pull the new cable into position and connect it at the rudder pedal and rudder bellcrank. Install the pulleys and pulley guides. Rig the cable as indicated in Paragraph 2.8.5.4.

2.8.5.4 Rigging Rudder -
Place an aligning rod in the holes provided in the pilot's rudder pedal and adjust copilot's rudder pedals to the neutral position by lengthening or shortening the link rod between the pilot and copilot's pedals as required. With the rudder pedals in neutral, bring the rudder to a neutral position and rig the cables to a tension of 35 pounds plus 5 pounds minus 0 pounds. The rudder travel is 25 plus or minus 1 degree left and 25 plus or minus 1 degree right. Adjustable stops are provided on the rudder pedal quadrant and at the rudder bellcrank.

NOTE

Since the nose wheel steering mechanism is interconnected with the rudder, center the nose wheel to maintain a neutral rudder setting.

2.8.6 Rudder Trim Tab System -
The rudder trim tab controls consist of a control wheel and position indicator mounted on the control console. The indicator is connected to the tab control system through a gear train. The trim tab control drives a cable drum wound with 1/16-inch cable which is routed aft under the floorboard to the rudder tab actuator. A rod connects the actuator to the tab horn.

2.8.6.1 Removal -
To remove the rudder trim tab cable, first remove the cabin floorboards, the tail section access cover and the tail cone. Then disconnect the section of cable to be removed, remove the pulley and pulley guards. Attach a cord or wire to the end of the cable to be removed and pull the cable out, drawing the guide into place.

2.8.6.2 Minor Repair and Parts Replacement.-
Corroded, rusted or frayed cables are considered unserviceable and must be replaced.

2.8.6.3 Rigging Rudder Tab -
Rigging of the rudder trim tab system is accomplished by setting the control knob on the control console to zero as indicated by the tab indicator. Then adjust the tab actuator mechanism and rudder tab to neutral. Rig the cable tension to 10 pounds, plus 3 minus 2 pounds. Rudder tab travel is 30 degrees left and 30 degrees right. The tab travel is limited by adjustable stops on the cable. These stops are adjusted to strike bulkhead 305 at extreme travel.

2.8.7 Flap Actuator System -
The flaps are extended and retracted by a motor and gearbox under the rear seat. From the gearbox, flexible shafts run outboard to each flap actuator, the upper shafts operating the outboard flaps and the lower shafts the inboard flaps. Both sets of shafts are driven by a common worm gear in the gearbox. The flexible shafts drive jackscrew actuators in the wings. Three limit switches are mounted on the right inboard flap, for full up, full down and take-off settings.

2.8.7.1 Removal -
(a) Remove inspection plate on lower surface of wing.
(b) Uncouple flexible drive shaft.
(c) Disconnect actuating arm from flap.
(d) Remove bolts from actuator bracket and remove actuator.
(e) Disconnect the four drive shafts from motor gearbox.
(f) Disconnect electrical leads.

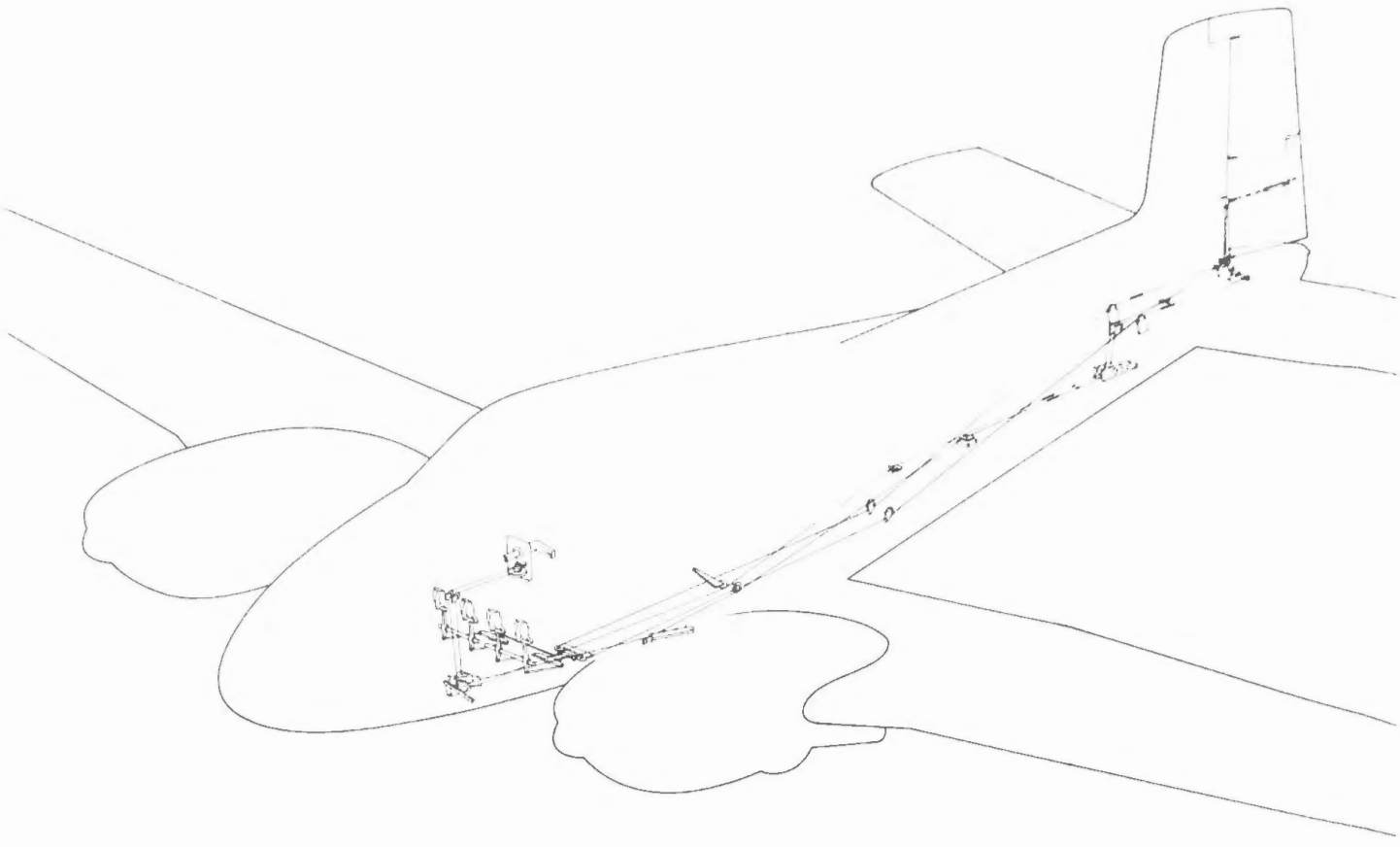


Figure 2-13. Rudder Control System

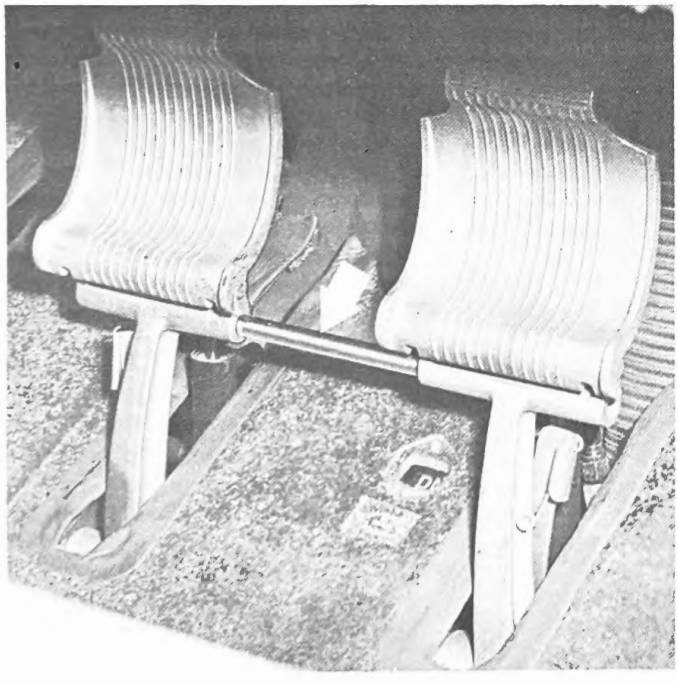


Figure 2-14. Rudder Rig Pin in Pedals

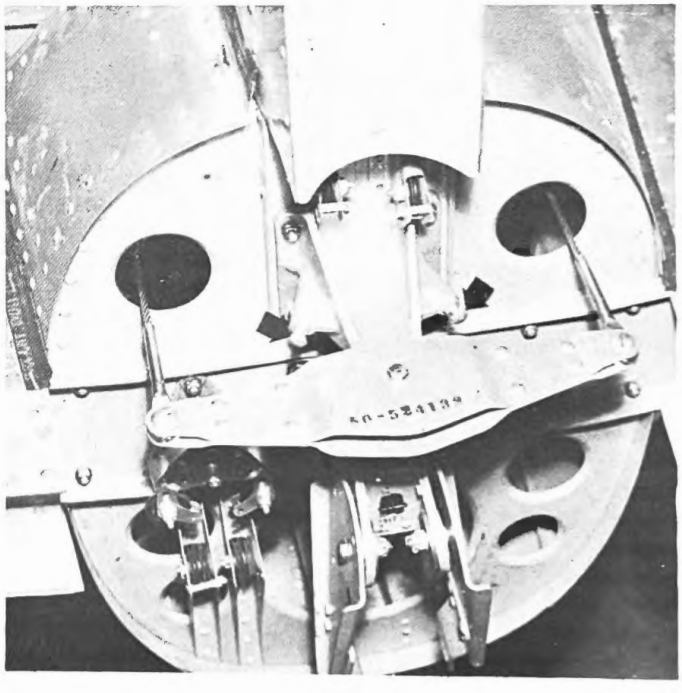


Figure 2-15. Rudder Bell Crank Stops

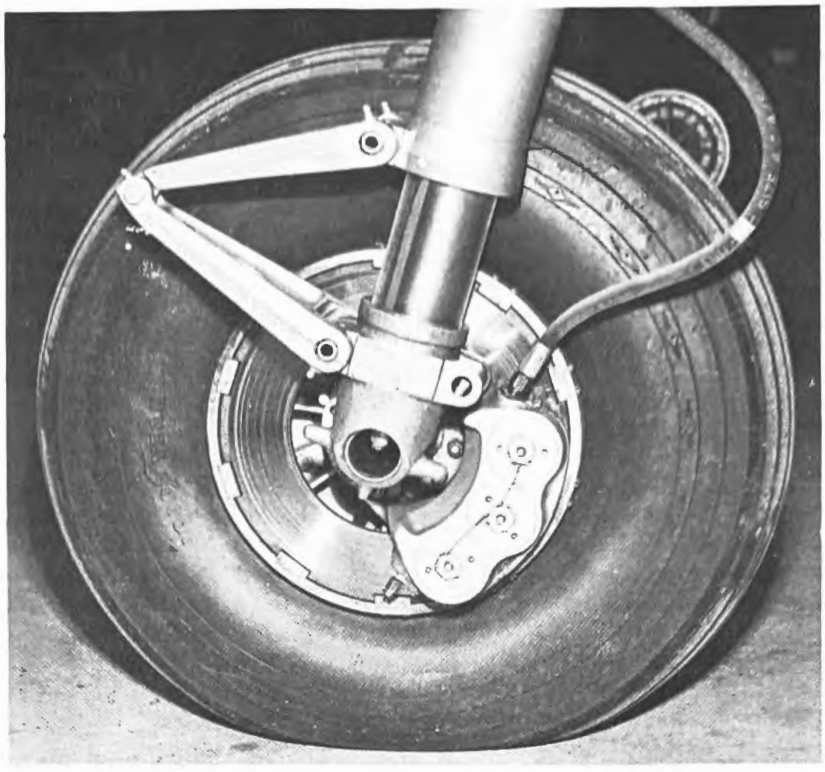


Figure 2-16. Wheel and Brake

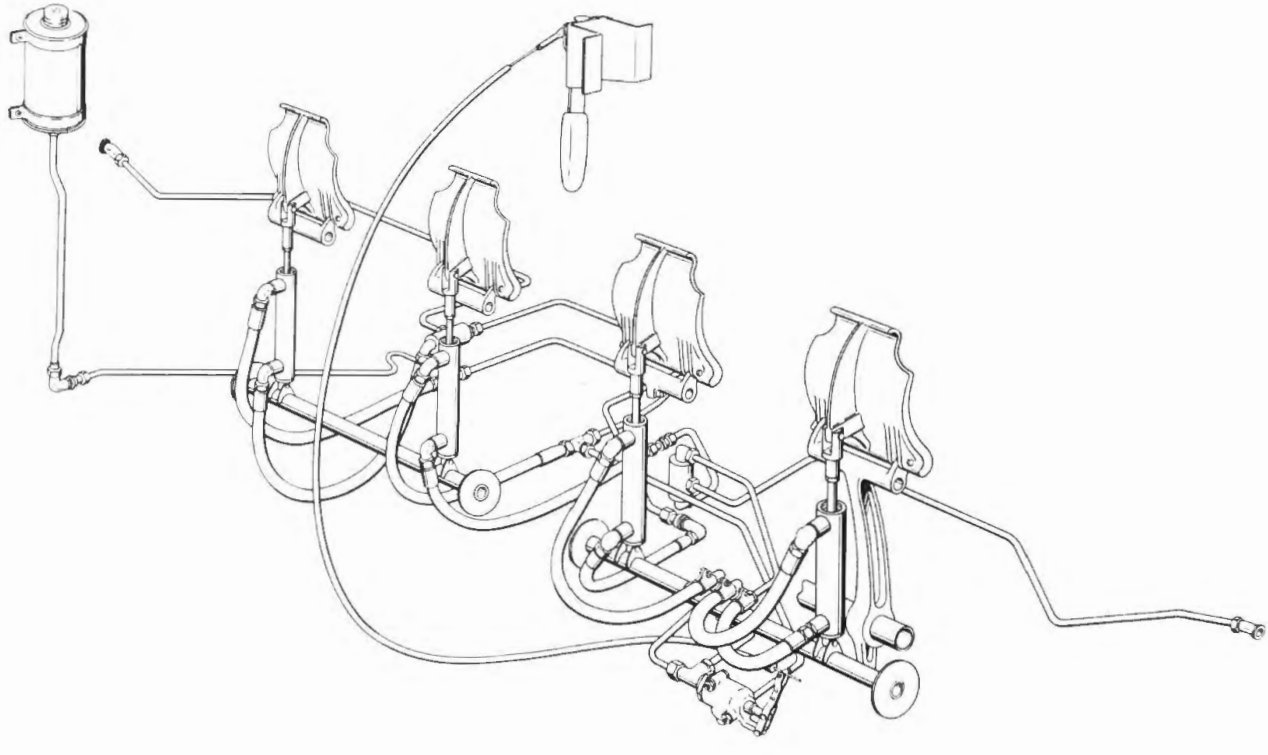


Figure 2-17. Brake Piping

(g) Remove two screws from lugs on base of housing and remove motor and gearbox.

2.8.7.2 Installation -
(a) Place actuator in position and install mounting bolts in bracket.
(b) Connect flexible drive shaft to actuator. Safety.
(c) Connect actuator arm and flap.
(d) Place motor in position and install mounting screws.
(e) Connect electrical leads to proper terminals.
(f) Connect flexible drive shafts to gearbox. Safety.

2.8.7.3 Rigging Flaps -
Flap travel is adjusted by moving the limit switches in their elongated mounting holes. The right inboard flap is rigged first, then the others are synchronized with it. Set the lower limit switch to 30 degrees, plus or minus 1 degree, and the take-off position switch to 20 degrees. Set the upper limit switch so the trailing edge of the wing slightly overlaps the leading edge of the flap. Synchronize the other three flaps by removing the bolts from the actuator arms at the flaps and screwing the arms in or out of the actuators.

## 2.9 LANDING GEAR

The airplane is equipped with a tricycle-type landing gear. The shock struts are an air-oil type and incorporate a rebound control. The completely retractable landing gear is electrically operated. The manual extension mechanism is provided for extension of the gear only in the event of an electrical failure and is not designed to retract the gear. The main wheel brakes are hydraulic single-disc type and are self-compensating. A steerable nose wheel is provided for easier ground handling and increased brake life. A hydraulic type shimmy dampener is provided on the nose wheel. The main and nose gear struts are manufactured so that the major portion of the parts are interchangeable from left to right main strut or to the nose wheel strut.

NOTE

Whenever the airplane is placed on jacks, the heater and blower circuit breaker should be turned off. If the gear is retracted on jacks with the heater and blower operating, the blower will shut off and an overheat condition will develop in the heater, due to insufficient airflow. When blower is shut off, the mixture is incorrect for proper combustion. The heater will ignite and force burning fuel out the exhaust pipe. This may create a fire hazard by igniting something under the airplane.

2.9.1 Nose Steering Mechanism -
The steerable nose wheel is connected to the rudder pedals through a system of push-pull tubes and hinge joints. A spring-loaded link in the system absorbs steering shocks which would otherwise be transferred to the rudder pedals. An automatic centering device assures proper wheel alignment for retraction.

2.9.1.2 Removal of Nose Steering Mechanism -
(a) Turn nose wheel to full left turn position.
(b) Remove nose steering link.
(c) Remove nose cone.
(d) Remove scissors links and yoke.
(e) Remove pilot's floor boards.
(f) Remove aft link and idler arm.

NOTE

On 100-hour inspection - check the nose wheel steering. Remove stop on steering and check lug on casting for cracks.

2.9.1.3 Wheels, Tires, and Tubes -
All three wheels are the split type, each half being statically balanced independently of the other. Main gear wheels are provided with hardened steel drive keys to accommodate the slots in the brake disc. Main wheel tires and tubes are 8:50 x 10 while the nose wheel uses size 6:50 x 10.

2.9.1.4 Removal -
(a) Jack the wheel up until it is clear of the ground. Jack points for one wheel jacking are provided on each strut.
(b) Remove the dust cover retaining ring, dust cover, and wheel retaining nut.
(c) Remove the wheel assembly. The brake disc should be supported to prevent its dropping out of position when the wheel is removed.
(d) Remove the valve core to deflate the tire.
(e) Break the bead of the tire loose from the wheel flange. Careful use of a rubber mallet is recommended for this operation.
(f) Remove the wheel assembly bolts, nuts and washers from the wheel halves.
(g) Split the wheel halves and remove the tire and tube.

2.9.1.5 Minor Repair and Parts Replacement -
(a) Wheels that are cracked or otherwise damaged to the extent that their strength is impaired cannot be repaired and must be replaced.
(b) Brake keys should be replaced when they show excessive wear or distortion in the area that contacts the disc. These keys are attached by one machine screw each and are readily replaceable.
(c) Bearing cones are a tight press fit in the wheel halves and may be removed by immersing the wheel in boiling water for 30 minutes or until thoroughly heated. Then chill the bearing cone to remove. Do not use a press or puller to remove a bearing cone.
(d) Bearings should be replaced when excessive wear is evident or a flat spot develops on a roller.

2.9.1.6 Installation -
(a) Install the completely deflated tube in the tire.
(b) Install the tire on the inner wheel half and insert the valve stem through the valve stem hole in the wheel half.
(c) Install the brake flange half of the wheel.

(d) Install the wheel assembly bolts, washers and nuts and tighten to equal torque. Care must be used to prevent pinching the tube between the wheel halves. The tire may be pushed down from the brake flange side to check the tube and wheel half separation before tightening the assembly bolts.
(e) Inflate and deflate the tire several times to seat the tire bead and remove any wrinkles in the tube.
(f) Install the valve core and inflate the tire to 35 psi.
(g) Install wheel bearings and grease retainers.
(h) Install the wheel on the axle; guide the brake disc over the wheel brake keys. Upon installation of the wheel, check to be sure that the wheel bearing is not cocked. A cocked wheel bearing will make wheel removal extremely difficult.
(i) Install wheel retaining nut and washer. Tighten the wheel retaining nut until the bearings drag when the wheel is turned then back the nut off until the wheel will turn freely. Safety the nut. (Bend the cotter pin ends until they will clear the bearing dust cover).
(j) Install the wheel dust cover and snap ring.

2.9.2 Wheel Brake Assembly -

The single disc brake consists of a disc keyed to the wheel and a housing which contains three interconnected wheel brake cylinders. Hydraulic pressure from the master cylinder pressurizes the wheel brake cylinders, forcing the movable brake linings laterally against the rotating disc and forcing the rotating disc against the stationary linings, resulting in a braking action. Brake lining wear is

self-adjusting, eliminating the need for periodic adjustment of the brake clearance.

2.9.2.1 Trouble Shooting -
See Chart 2-1, Brake Trouble Shooting.

2.9.2.2 Removal -
(a) Jack the airplane up until the wheel or wheels are well clear of the ground.
(b) Remove the bearing dust cover, wheel retaining nut and washer.
(c) Remove the wheel and bearings. The brake disc should be supported to prevent it from dropping and striking the axle.
(d) Remove the brake disc and brake lining.
(e) Disconnect the brake hydraulic line.
(f) Remove the brake housing attaching bolts.
(g) Remove the brake housing from the axle.

2.9.2.3 Minor Repair and Parts Replacement -
The brake lining should be replaced when only 1/16-inch of the brake cylinder adjusting pin protrudes from the packing nut. The brake disc should be replaced if excessive heat warpage occurs or the key slots become excessively worn or badly burred. Discoloration or scoring of the disc does not affect the operation of the brake and is not cause for replacement.

2.9.2.4 Disassembly of Wheel Cylinder -
(a) Remove safety wire and back off adjusting pin packing nut.
(b) Remove cylinder head with appropriate spanner wrench.
(c) Remove piston and wash all parts with denatured alcohol.
(d) Replace damaged seals or other parts.

2.9.2.5 Assembly of Wheel Cylinder -
(a) Lubricate cylinder walls and seals with hydraulic fluid and insert piston.
(b) Turn cylinder head in until flush with housing.
(c) Torque adjusting pin packing nut to 15 foot-pounds and safety.

2.9.2.6 Installation -
(a) Place the brake housing in position and install the retaining bolts.
(b) Connect the hydraulic brake hose to the housing.
(c) Install the stationary and movable brake lining in the housing.
(d) Press the movable lining back into the housing and install the brake disc.
(e) Support the disc and install the wheel and bearing.
(f) Install the wheel retaining nut and washer.
(g) Install the dust cover and dust cover retaining ring.
(h) Bleed the brakes as outlined in Paragraph 2.9.3.9.

2.9.3 Brake Master Cylinders -
The brake master cylinders are of the compensating barrel type which maintain a constant and correct volume of fluid in the system by replacing from the reservoir any fluid lost by leakage in the system. The master cylinder pistons are actuated by toe brakes on the pilot's and copilot's rudder pedals. "O" ring seals are used on the piston and for the seal around the piston rod and the brake cylinder cap.

2.9.3.1 Trouble Shooting -
See Chart 2-1, Brake Trouble Shooting.

2.9.3.2 Removal -
(a) Remove front floorboard.
(b) Disconnect and plug the fluid line from the reservoir.
(c) Remove master cylinder attaching bolts at the upper and lower end of the master cylinder. Remove unit.

2.9.3.3 Disassembly -
(a) Remove the snap ring which holds the cap in position.
(b) Pull on actuating rod to remove piston.

2.9.3.4 Cleaning -
Use brake fluid, Specification MIL-O-5606 or alcohol for cleaning the master cylinder or brake parts.

2.9.3.5 Minor Repairs and Parts Replacement.-
(a) Clean all parts with alcohol.
(b) Inspect seals. Replace if worn or hard. If cylinder shows signs of leakage, replace all seals.
(c) Replace weak or broken return springs.

2.9.3.6 Assembly -
(a) Install return spring.
(b) Install piston and cap.
(c) Install the lock rings.

2.9.3.7 Installation -
(a) Place the master brake cylinder in position on the rudder pedal and install the attaching bolts.
(b) Connect the brake lines to the master cylinder.
(c) Replace the floorboard.
(d) Bleed the brake system as outlined in Paragraph 2.9.3.9.

2.9.3.8 Adjustment of the Brake Master Cylinder Linkage -
(a) Loosen lock nut on piston shaft.
(b) Remove pin from clevis on back of rudder pedal and slide clevis free of lug.
(c) Adjust length of shaft by turning clevis on or off shaft, as required.
(d) Reinstall clevis and pin, safety the pin and tighten lock nut.

2.9.3.9 Bleeding the Brake System -
Brake system bleeding will be required any time the system is opened any place from the master cylinder inlet to the wheel brake assembly or in the event the brakes become spongy in service.

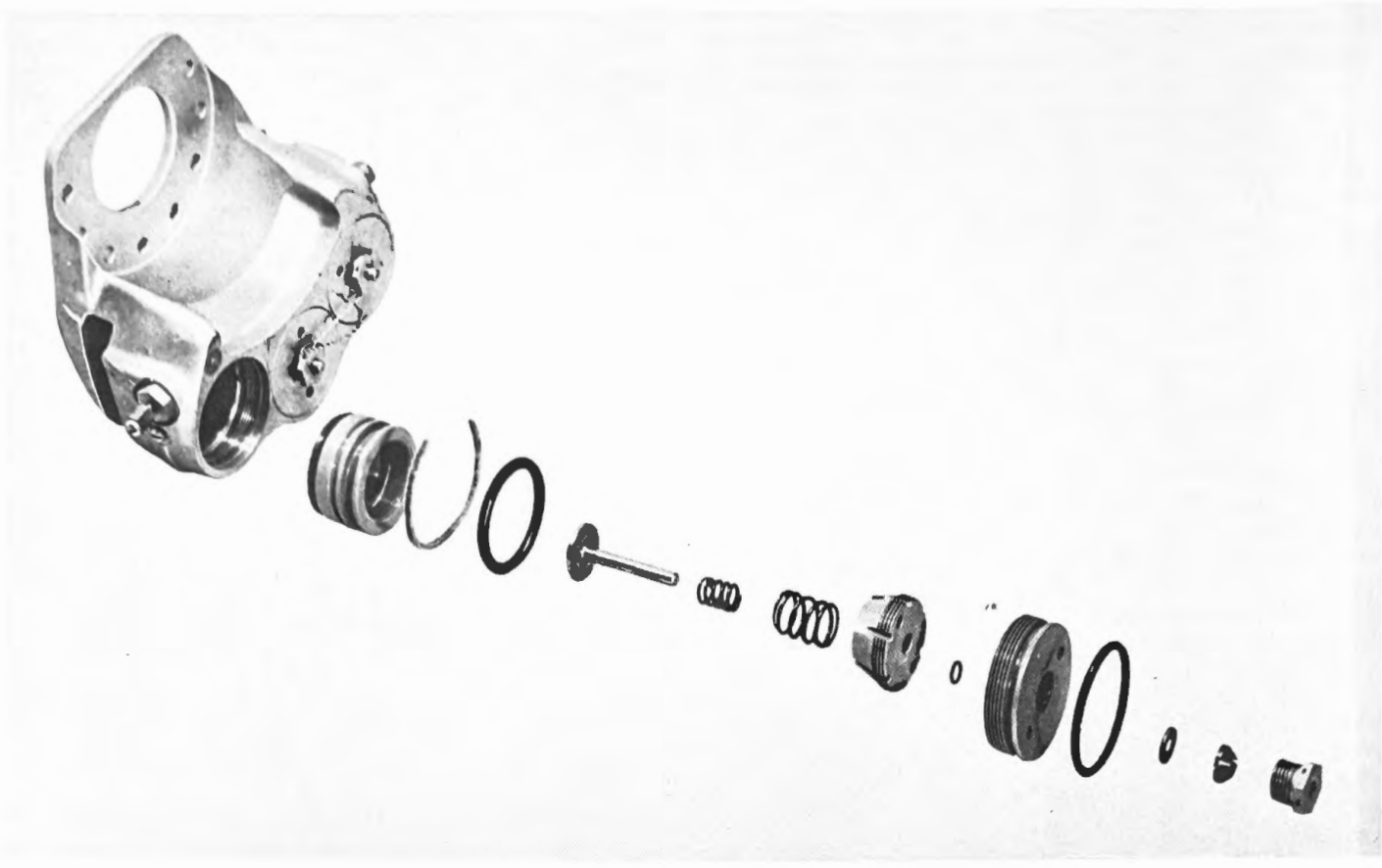


Figure 2-18. Wheel Brake Cylinder

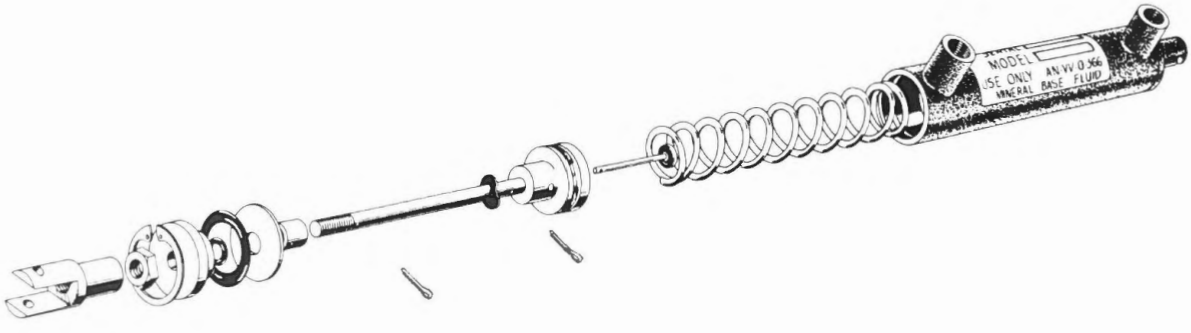



Figure 2-19. Master Cylinder

The latter case is ordinarily an indication of a leak in the system and the system should be checked.

The brakes can be bled using any of the several proven methods for brake bleeding. However the most efficient system is back-bleeding using a pressure pot and bleeding the system from the wheel cylinder up in the following manner:

(a) Drain the hydraulic reservoir.
(b) Disconnect the system supply line from the reservoir.
(c) Connect an extension line approximately three feet long to the brake supply line and place the open end in a clean container.
(d) Connect the pressure pot to one of the brake cylinder bleeder valves.
(e) Maintain a pressure of approximately 15 pounds on the pressure pot and open the bleeder valve. Bleed the pilot's brake until all evidence of sponginess is gone. When the pilot's brake is satisfactory, close the valve on the pressure pot and pump the copilot's brake pedal to change the shuttle valve position so the fluid will be routed through the copilot's brake system. Bleed the copilot's brakes in the manner described above for the pilot's brakes. After the pilot's and copilot's brakes for one wheel are bled, close the bleeder valve and repeat the process for the other wheel.
(f) Remove the supply line extension hose and connect the supply line to the reservoir.
(g) Fill the hydraulic reservoir to within one inch of the top.
(h) In some instances, the parking brake will not hold properly due to air in the system between the parking brake valve and the pilot's master brake cylinder. This condition can be corrected by loosening the inlet hose connection at the brake cylinder and allowing fluid to flow from the reservoir until the air is expelled.
(i) Check the brake operation; pedal pressure should be equal on both pedals.

2.9.4 Shock Struts -

The shock struts are of the air-oil type. The major components are the piston, cylinder, rebound control and an extension stop pin. The piston operates in bearings inside the cylinder. The upper bearing contains an O-ring which seals the piston. An orifice ring machined on the inside of the piston aids in control of the flow of fluid between the piston and upper cylinder. The rebound control assembly consists of a control cylinder supported at the top by the strut cylinder and a plastic rebound control valve in the lower portion of the rebound control cylinder. On landing, fluid from the lower cylinder unseats the plastic control valve and allows fluid to be metered through the valve orifices into the main cylinder. The main gear struts are completely interchangeable, left-hand to right-hand. There are are also certain parts of the main and nose gear struts that are interchangeable such as the rebound control assembly.

2.9.4.1 Removal -

(a) Jack up the airplane so the wheels are well clear of the ground.
(b) Disconnect hydraulic brake lines and attaching fittings.
(c) Retract the gear slightly to take the load off the drag leg.
(d) Remove the safety switch and step retraction switch boxes from the strut.
(e) Disconnect the drag leg at the strut fitting.
(f) Remove the landing gear bolt access hole cover.
(g) Place blocks under the wheel to remove part of the load on the attaching bolts and to support the strut when the bolts are removed.
(h) Remove the attaching bolts and lower the strut away from the airplane.

2.9.4.2 Disassembly -

(a) Remove the wheel.
(b) Remove the bolts attaching the brake housing to the axle and remove the housing.
(c) Release the strut air pressure by backing off the filler valve.

CAUTION

Unscrew the filler valve only until the air begins to escape. Do not attempt to remove the valve until the air pressure is entirely dissipated.

(d) Remove the bolt in lower brace strut fitting.
(e) Remove the bolts attaching the strut head to the strut.
(f) Remove the torque knee.
(g) Remove the cylinder cap retaining snap ring and the cap.
(h) Hold the extension stop with a long screwdriver and remove the extension stop nut.
(i) Remove the rebound assembly and extension stop.
(j) Remove the piston from the cylinder.
(k) Remove the wiper, scraper and snap ring from the bottom of the cylinder.
(l) Remove the O-ring seal from the upper cylinder bushing.
(m) Remove the felt lubrication pad from the lower part of the cylinder.

2.9.4.3 Minor Repair and Parts Replacement -

(a) Replace worn strut knee bushings, damaged parts and fittings.
(b) Replace all O-ring seals.
(c) Clean all the internal parts of the strut in alcohol or MIL-O-5606 hydraulic fluid.
(d) Wash the lubrication felt in clean unleaded gasoline and saturate with light engine oil.

2.9.4.4 Assembly -

(a) Install new O-ring seal in upper cylinder bushing.
(b) Install the lubrication felt in the cylinder.
(c) Install the snap ring, scraper and wiper on the piston in the order given.
(d) Install the piston in the cylinder.

(e) Install the rebound control assembly and extension stop pin in the strut.
(f) Fit the wiper and scraper into place and secure snap ring.
(g) Install the torque link.
(h) Install a new O-ring seal in the top of the cylinder and install the top cap and snap ring.
(i) Install the strut head and brace strut.
(j) Attach the brake housing.
(k) Install the wheel.
(l) Fill the strut with clean hydraulic fluid Specification MIL-O-5606. Fill to the bottom of the valve standpipe with the strut in the compressed position. The fluid quantity per strut is approximately 3-1/2 quarts. It is advisable to work the strut two or three times to remove any trapped air. Recheck the fluid level.
(m) Install the filler valve.
(n) Inflate the strut to 80 pounds psi.
(o) Check the strut for correct inflation after installation. Correct inflation height for the main gear strut is three inches with the weight of the airplane on the strut.

2.9.4.5 Installation -
(a) Raise the strut to position in the wheel well and install the upper hinge bolts.
(b) Attach the strut and the retract link.
(c) Install the step retract and landing gear safety switch (right strut only).
(d) Connect the hydraulic brake hose and bleed the brakes as outlined in Paragraph 2.9.3.9.

2.9.5 Landing Gear Retract System -
The landing gear is extended or retracted by an electric motor which drives a jackscrew actuator on each unit. The main gear actuators are driven by torque shafts from the motor gearbox under the front seat. The nose gear is driven by a chain from a sprocket on the right gear torque shaft. A spring-loaded friction clutch between the gearbox and the torque shafts protects the system in the event of malfunction. A lever projecting up and forward between the front seat sections extends the gear manually should the electrical system fail. The gear cannot be retracted manually.

Position indicator lights, red for gear up and green for gear down, are located beneath the position switch on the instrument subpanel. A mechanical indicator on the floorboard is operated by the nose gear mechanism. Resistors are switched into the position light circuits to dim the light for night flying when the navigation lights are switched on.

Positive mechanical down locks, operated by slotted actuator attachments, are fitted to the drag braces. The irreversible jackscrew in each actuator holds the gear retracted. A safety switch on the right main gear prevents retraction when the strut is compressed and a warning horn sounds if the throttles are retarded with the gear up.

2.9.5.1 Landing Gear Motor -
The landing gear motor is a split-field, series-wound type. One set of fields is used to drive the motor in each direction. To prevent overtravel of the gear, the motor also is used as a dynamic brake; a relay simultaneously breaks the power circuit to the motor and makes a complete circuit through the armature and the unused field winding. The motor then acts as a generator and the resulting mechanical load on the armature stops the gear almost instantly.

2.9.5.1.1 Removal, Landing Gear Motor -
(a) Disconnect electrical leads to motor.
(b) Remove clutch throw out arm.
(c) Remove clamp attaching forward end of motor.
(d) Remove nuts attaching motor to gearbox.
(e) Remove motor.

2.9.5.1.2 Minor Repairs and Parts Replacement.-
Only cleaning of commutator with fine sandpaper and gasoline and replacement of worn brushes should be undertaken in the field. After cleaning commutator, blow out all sand and dirt with a dry air jet. For more extensive repairs, the motor should be sent to a BEECHCRAFT Certified Service Station.

2.9.5.1.3 Installation, Landing Gear Motor -
(a) Insert motor in bracket.
(b) Install attaching nuts.
(c) Install clamp.
(d) Install clutch throw out arm.
(e) Connect electrical leads.

2.9.5.1.4 Trouble Shooting -
See Chart 2-2, Trouble Shooting, Landing Gear Motor and Switch.

2.9.5.2 Landing Gear Gearbox and Clutch -
A gearbox employing bevel gears and ball bearings connects the landing gear cross shafts and motor. The gears are matched and prelubricated and the unit is sealed. The spring-loaded disc clutch protects the system from overloads and absorbs the shock of starting and stopping. A manually-operated clutch disconnects the clutch and gearbox for easier emergency extension with the hand lever.

2.9.5.2.1 Removal of Gearbox -
(a) Jack airplane and support tail section.
(b) Remove forward access panel at right wing root.
(c) Remove bolt attaching universal to cross shaft.
(d) Remove the 3 bolts attaching bearing block to side of fuselage.
(e) Remove front seats and access covers beneath them.
(f) Remove up and down limit-switch bracket.

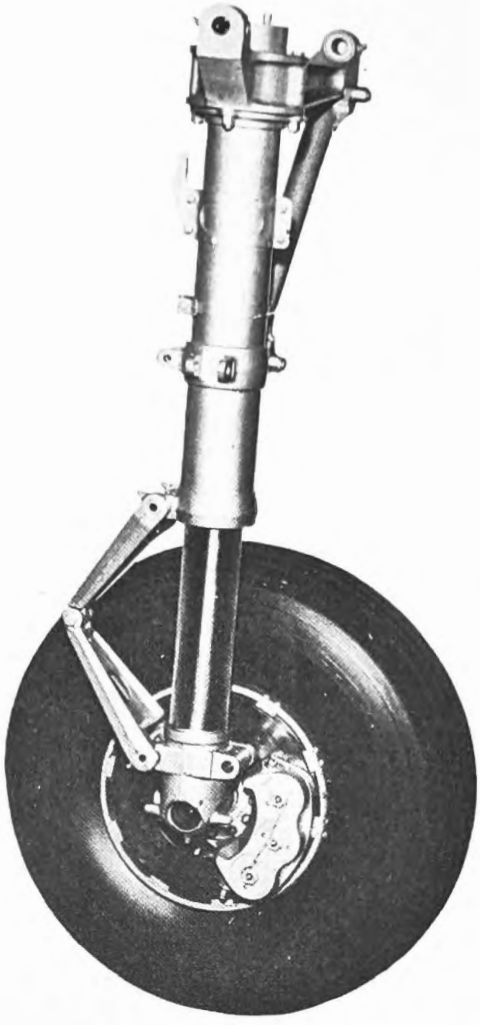


Figure 2-20. Main Gear Shock Strut

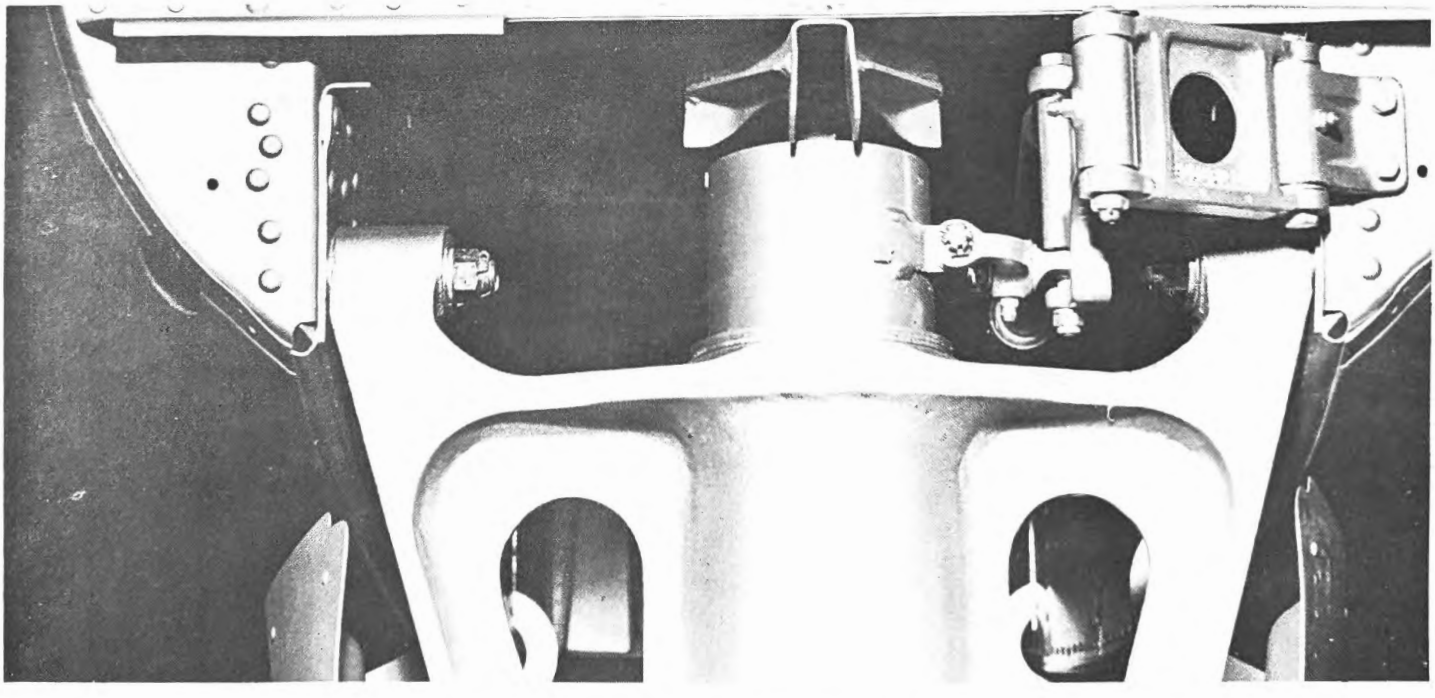


Figure 2-21. Nose Steering Mechanism

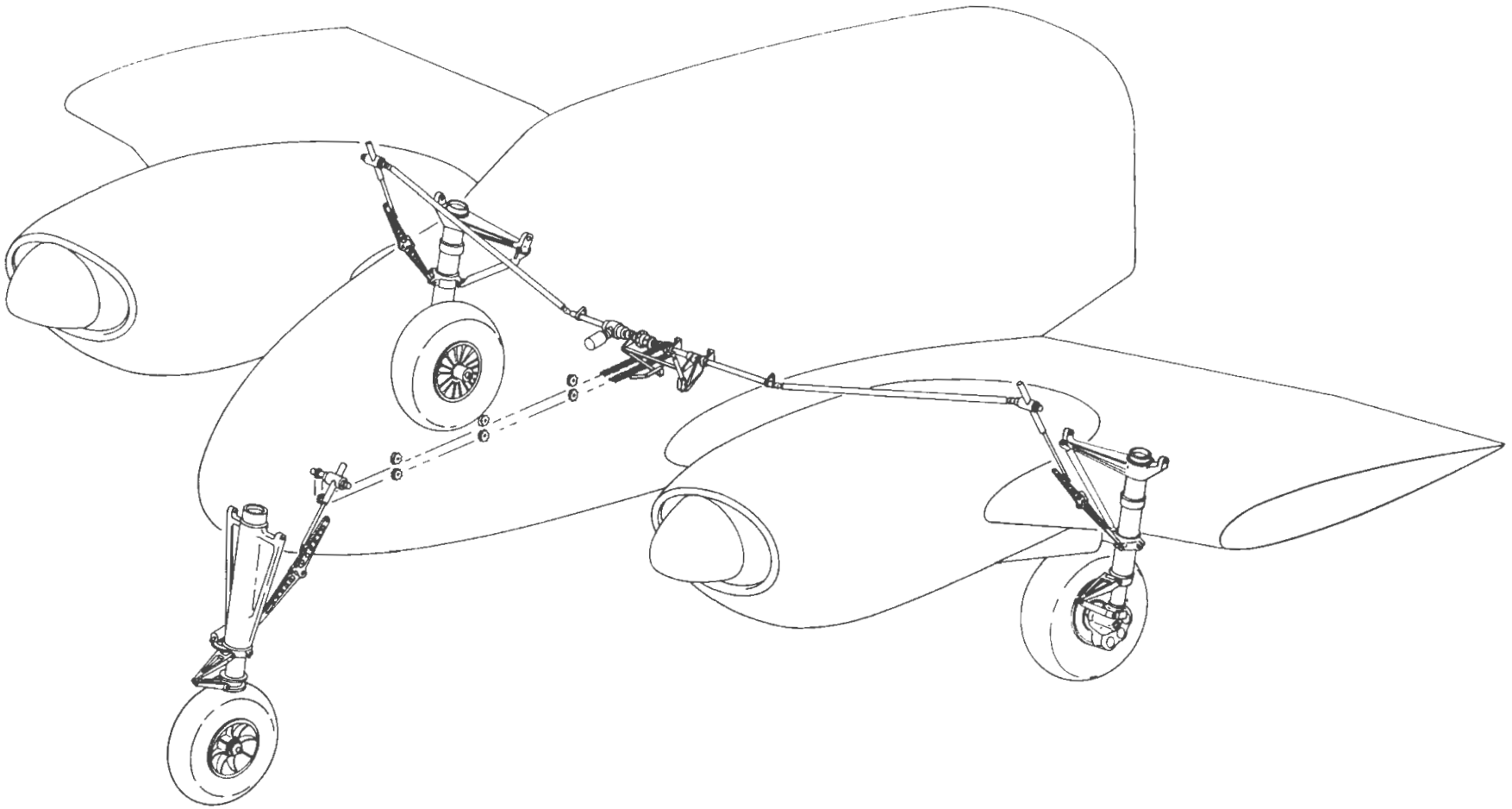


Figure 2-22. Landing Gear Retract System

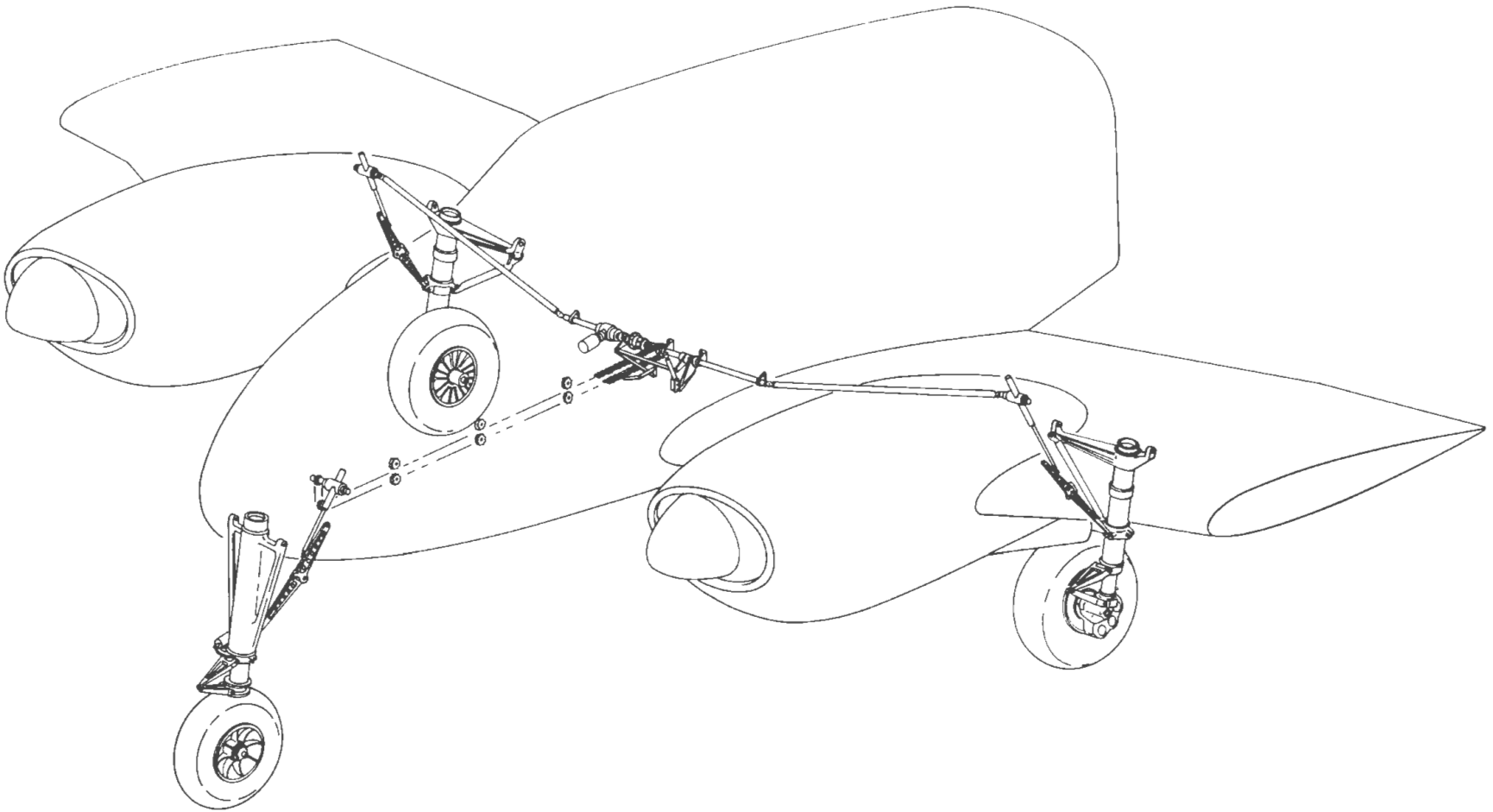


Figure 2-22. Landing Gear Retract System

(g) Disconnect clutch throwout arm from linkage.
(h) Remove bolt attaching gearbox to front spar.
(i) Remove the 2 bolts from cross shaft between sprocket and clutch.
(j) Compress spring encircling cross shaft without disengaging manual clutch, and remove gearbox and clutch assembly.

2.9.5.2.2 Installation -
(a) Insert gearbox and clutch assembly, compressing spring encircling cross shaft sufficiently to allow inboard end of cross shaft to enter the mating tube near sprocket.
(b) Align holes through cross shaft between sprocket and clutch and install respective bolts.
(c) Install bolt attaching gearbox to front spar.
(d) Connect linkage to clutch throw-out arm.
(e) Install up and down limit-switch bracket.
(f) Install the 3 bolts attaching bearing block to side of fuselage.
(g) Install bolt attaching universal to cross shaft.
(h) Test retraction system for proper operation through at least one complete cycle.
(i) Replace access panel at right wing root.
(j) Replace access covers and seats in cabin.

2.9.5.2.3 Over-load Clutch Testing and Adjustment -
(a) With airplane on jacks, place short length of steel pipe or similar support between positive up stops.
(b) Place strap wrench around overload clutch housing and manually raise gear until positive stops bottom on pipe.
(c) Attach spring scale to handle of wrench, measuring from point of attachment to center line of clutch to determine length of arm.
(d) Clutch should slip at a torque of 270 inch-pounds plus or minus 30 inch-pounds.(A scale reading of 45 pounds on the scale if attached 6 inches from the clutch center line indicates a torque of 270 inch-pounds).
(e) If not within tolerances, loosen lock screw on tension nut and spread slightly, if seized. Using Beech Spanner Wrench 180131, tighten nut to increase tension or loosen to decrease it. Tighten lock screw on nut and resafety.

2.9.5.2.4 Manual Clutch Adjustment -
(a) Space washers on bolt connecting throw-out arm to linkage to allow 1/16-inch clearance between clutch teeth when fully disengaged.

2.9.5.3 Landing Gear Retract Actuators -
Similar jackscrew type actuators retract both main and nose gear; however, none are interchangeable. Bevel gearing from the torque tube drives the screw assembly which produces the required telescopic action. A spring on the movable end of the unit serves as a shock absorber, preventing strain on component parts should the three actuators not all bottom at the same instant.

NOTE

The nut on the right actuator has left hand threads; the left and nose gear actuators have right hand threads.

2.9.5.3.1 Removal of Jackscrew Actuators (Main Gear) -
(a) Jack airplane and support tail section.
(b) Remove screws attaching stiffener plate to actuator bracket.
(c) Remove bolt attaching universal to actuator.
(d) Operate actuator manually until tension is relieved on actuator shock spring.
(e) Remove bolt attaching actuator to drag brace.
(f) Remove outboard and inboard bearing supports.
(g) Remove forward access panel at wing root.
(h) Remove 2 bolts through universal at wing root and telescope the tube universal in torque tube and cross shaft until bottomed, to allow clearance for disconnecting actuator.
(i) Rotate actuator assembly 90 degrees from mounting position and remove.

2.9.5.3.2 Installation and Adjustment (Main Gear ) -

NOTE

Lubricate the jackscrew actuator with a mixture of MIL-G-3278 grease and Molykote, Type Z, 15 grams of Molykote to a pound of grease. To prevent the grease causing a hydraulic lock, fill the nut assemblies only half full and screw them all the way in before connecting them to the gear.

(a) Insert actuator in mounting position.
(b) Install bolt attaching universal to actuator.
(c) Install outboard and inboard bearing supports.
(d) Install bolt attaching actuator to drag brace.
(e) Manually rotate torque tube until actuator shock spring is compressed approximately 1/8-inch after actuator attachment bolt bottoms in slot.
(f) Install 2 bolts through universal at wing root.
(g) Install 6 screws attaching stiffener plate to actuator bracket.
(h) Test retraction system for proper operation through at least one complete cycle.

2.9.5.3.3 Removal (Nose Gear) -
(a) Jack airplane and support tail section.
(b) Remove the six screws attaching actuator drive shaft housing to bulkhead in forward baggage compartment.
(c) Remove snap ring holding drive shaft in place.
(d) Slide drive shaft away from actuator and loosen tension on actuator shock spring by backing off actuator with a pin or bolt through hole in actua-

tor shaft.
(e) Remove bolt attaching actuator to drag brace.
(f) Remove both bearing supports.
(g) Rotate actuator assembly 90 degrees from mounting position and remove.

2.9.5.3.4 Installation and Adjustment (Nose Gear) -

NOTE

Pack actuators with MIL-G-3278 grease. Fill jackscrews with a mixture of Molykote, type Z, 15 grams per pound of grease. Avoid filling the jackscrews too full of mixture and causing a hydraulic lock.

(a) Insert actuator in mounting position.
(b) Install both bearing supports.
(c) Install bolt attaching actuator to drag brace.
(d) With pin or bolt through hole in actuator shaft, manually turn shaft until actuator shock spring is compressed approximately 1/8 inch after actuator attachment bolt bottoms in slot.
(e) Place drive shaft in position with actuator and install snap ring.
(f) Test retraction system for proper operation through at least one complete cycle.
(g) Install drive shaft housing.

2.9.5.4 Nose Gear Retract Chain -
A double chain approximately 17 feet 9 inches long drives the nose gear retract mechanism. Four sets of idler sprockets maintain tension and alignment of the chain.

2.9.5.4.1 Removal -
(a) Jack airplane and support tail section.
(b) Remove front seats, access panels, pilot's compartment floor boards and forward baggage compartment floor panel.
(c) Loosen bolts securing first set of idlers forward of drive sprocket releasing tension on chain.
(d) Locate quick-disconnect link and disassemble.
(e) Remove the six screws attaching actuator drive-shaft housing to bulkhead in forward baggage compartment.
(f) Remove bolt connecting drive shaft to actuator.
(g) Remove chain.

NOTE

If a new chain is to be installed it may be fastened to the old chain with quick-disconnect link and pulled into place as the old one is removed. If original chain is to be reinstalled, a length of safety wire or fish tape may be used in the same manner, to facilitate reinstallation.

2.9.5.4.2 Installation and Adjustment -
(a) Thread chain over sprockets, connecting ends near drive sprocket.

NOTE

Check each sprocket for proper tracking of chain. At the 100-hour inspection, check to see that the chain is on sprocket and that the sprocket isn't binding.

(b) Install bolt connecting drive shaft to actuator in forward baggage compartment.
(c) Install actuator drive-shaft housing.
(d) Adjust tension of chain with movable idler sprocket and tighten attachment bolts. If chain cannot quite be squeezed together with thumb and forefinger midway between adjustable idler and next idler forward, tension is satisfactory.
(e) Test retraction system through at least one complete cycle, making sure that chain tracks properly.
(f) Replace floor boards, access panels and seats.

NOTE

The retract chain should be kept free of dirt, rust and corrosion at all times. Cleaning should be accomplished only with an approved solvent and under no circumstances should rust or corrosion be removed with an acid cleaner. Acid cleaners may embrittle and crack the highly heat-treated links. If a chain is excessively rusted or corroded, it should be replaced. The only recommended lubricant is powdered graphite which may be mixed with a quick-evaporating solvent and applied to the chain with a brush.

2.9.5.5 Landing Gear Synchronization -
Following the repair or replacement of any part of the retract system, place the airplane on jacks and check synchronization of the landing gear in both extended and retracted position. There are several adjustments which will alter the travel of the retract mechanism; a combination of these adjustments may be required to synchronize all three gears for identical ranges of travel. When fully extended, each actuator spring should be compressed 1/8 inch. When fully retracted, there should be a 1/16 inch clearance between each wheel axle and its up-stop bumper and each strut point and its up-stop bumper.

NOTE

If all three gears are synchronized, but stop too early or too late at either limit of travel, correct by resetting limit switch concerned.

CAUTION

Following any rigging adjustment, the retract mechanism should be operated cautiously as it nears extreme of travel, in order to prevent damage from possible overtravel. With master switch off, position the landing gear switch for the desired direction of travel. The gear then may be moved to any intermediate position and stopped for synchronization checks by operating

the master switch until the desired position is reached.

2.9.5.6 Rigging Main Landing Gear -
With the airplane on jacks, use the following procedures:
(a) A major adjustment of either main gear may be made by removing the bolt securing the jackscrew actuator to the drag leg and turning the screw (a half turn at a time) in or out as required.

CAUTION

The actuator clevis must align freely with the drag brace fitting. If any misalignment is evident, loosen the actuator support bolts, realign the clevis and retighten the bolts. Failure to maintain proper alignment will result in galling of the actuator nut.

(b) An alternate means of adjustment is to remove the bolts from the universal joint nearest the actuator and turn the drive shaft (with a pin inserted through the shaft hole) to actuate the jackscrew to the desired position.
(c) Fine adjustments to the main gear may be obtained by changing the position of the universals (at the wing root) on the splined drives.
(d) Make certain landing gear position switch is in the DOWN position, then reset circuit breakers and move jacks.

NOTE

When the main landing gear doors are properly rigged, to the UP position, considerable "play" in the doors and linkage can be noted when the gear is in the DOWN position. It is recommended that the landing gear door rigging be inspected at each intermediate inspection or more often if deemed necessary.

2.9.5.7 Rigging Nose Landing Gear -
(a) Conditions requiring a major readjustment may be corrected in the same manner as outlined in step a, paragraph 2.9.5.6.
(b) Fine adjustments of the nose gear may be obtained by changing the position of the drive shaft on the splined drive at the actuator, as follows:

1. Release the tension on the retract chain.
2. Remove the snap ring on the opposite side of the bearing from the sprocket.
3. Slide the shaft outboard until it is free of the splined drive.
4. Change the position of the drive shaft on the splined drive as required to obtain the desired action on the gear. Replace shaft on spline.
5. Replace the snap ring in its groove.
6. Restore chain tension.

(c) Make certain landing gear switch is in the DOWN position and reset circuit breakers and remove jacks from the airplane.

2.9.6 Landing Gear Electrical System -

2.9.6.1 Landing Gear Position Switch -
The landing gear position switch, located to the right of the control column on the subpanel, controls the landing gear motor through a dynamic-brake relay assembly mounted beneath the front passenger seat. To prevent accidental retraction on the ground, a locking lever to the left of the switch must be disengaged before switch can be moved.

2.9.6.1.1 Trouble Shooting -
See Chart 2-1, Trouble Shooting, Landing Gear Motor and Switch.

2.9.6.2 Up-Limit Switch -
The landing gear up-limit switch is located on the left side of the limit-switch bracket on the front spar adjacent to the landing gear motor. When fully retracted position is reached, it opens the circuit to the landing gear motor and simultaneously closes the circuit to the red "up" indicator light.

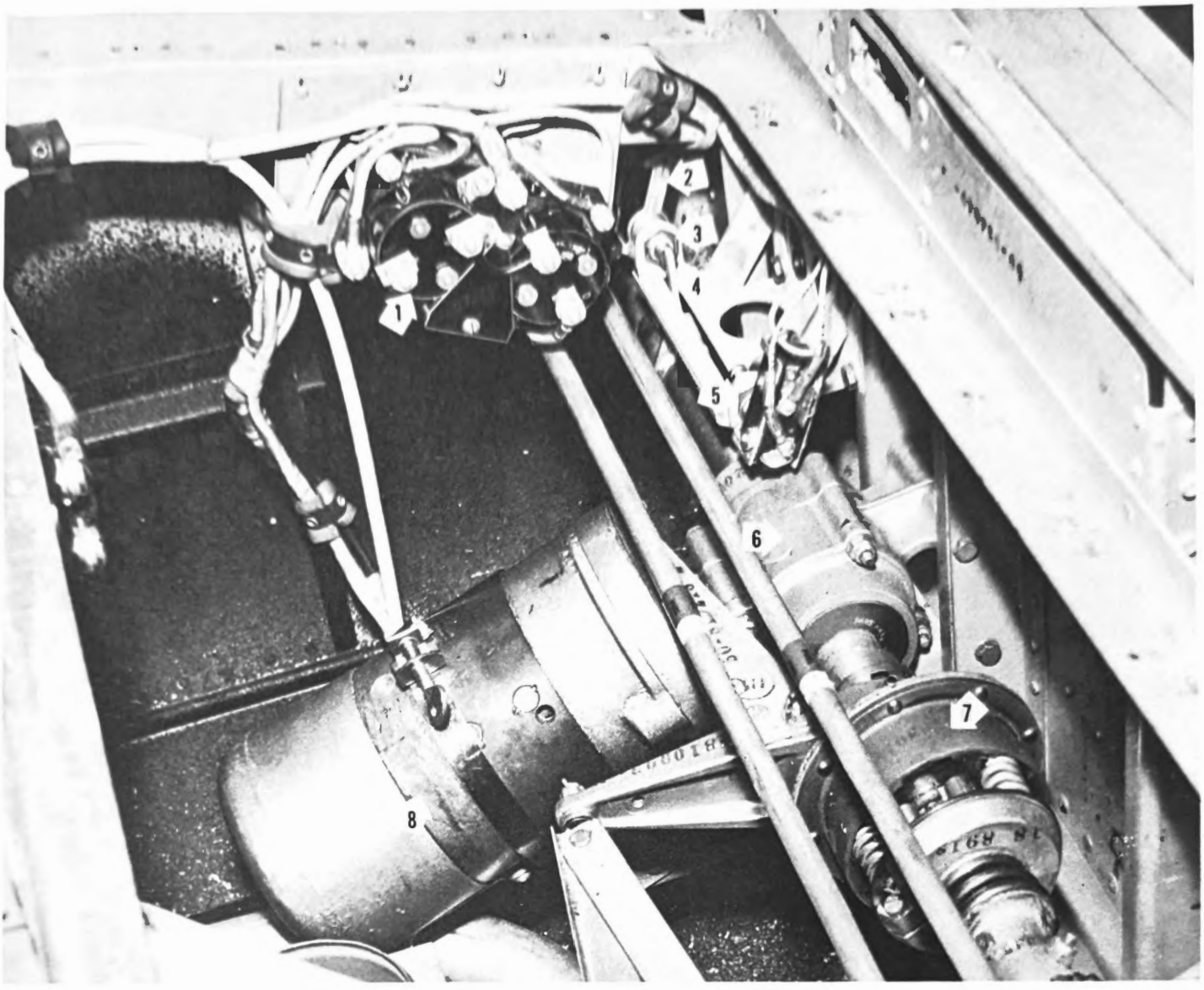
2.9.6.2.1 Trouble Shooting -
See chart 2-3, Trouble Shooting, Limit Switches and Safety Switch.

2.9.6.2.2 Adjustment -
(a) Jack airplane and support tail section.
(b) Retract gear until positive up stops are approximately 1/16 inch apart.

NOTE

A gage may be fashioned to take this measurement through the nacelle opening directly beneath the inboard positive up stop.

(c) Adjust up-limit switch with hexagonal mounting nuts so that plunger is depressed 1/16 inch beyond point where switch clicks.
(d) Completely extend gear and again retract it without stopping in an intermediate position.
(e) Make fine adjustments with above mounting nuts, if necessary, until switch stops retraction when positive up stops are 1/16 inch apart.




1. Dyanmic Brake Relay
2. Down Limit Switch
3. Down Limit Switch Adjusting Nut
4. Traveling Arm
5. Up Limit Switch Adjusting Nut
6. Motor Gearbox
7. Overload Clutch
8. Landing Gear Motor

Figure 2-23. Landing Gear Motor and Limit Switches

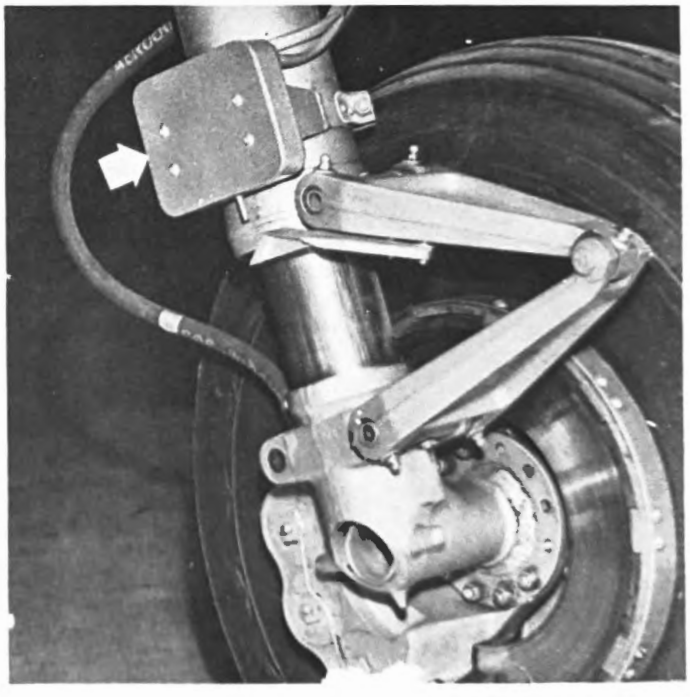


Figure 2-24. Landing Gear Safety Switch

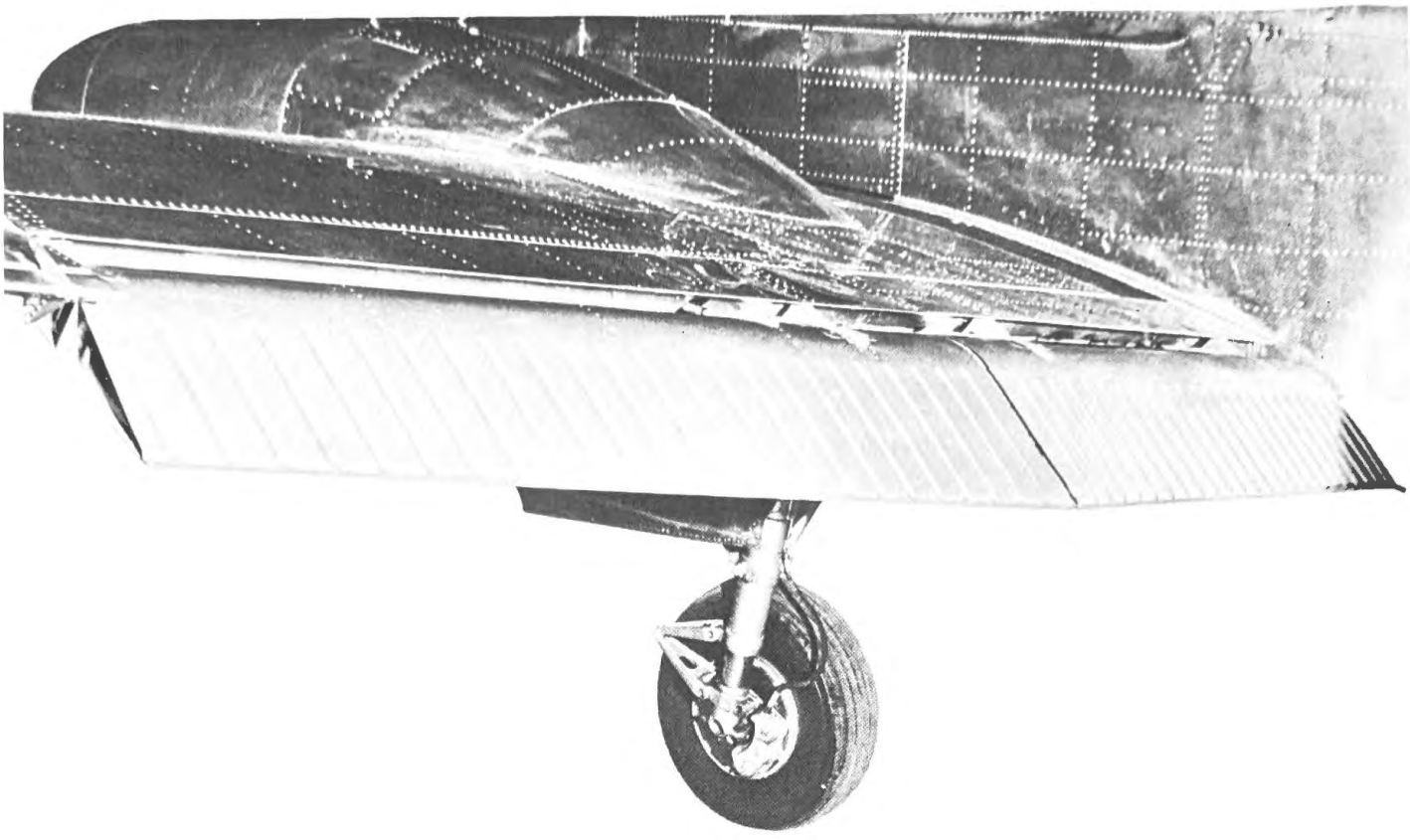
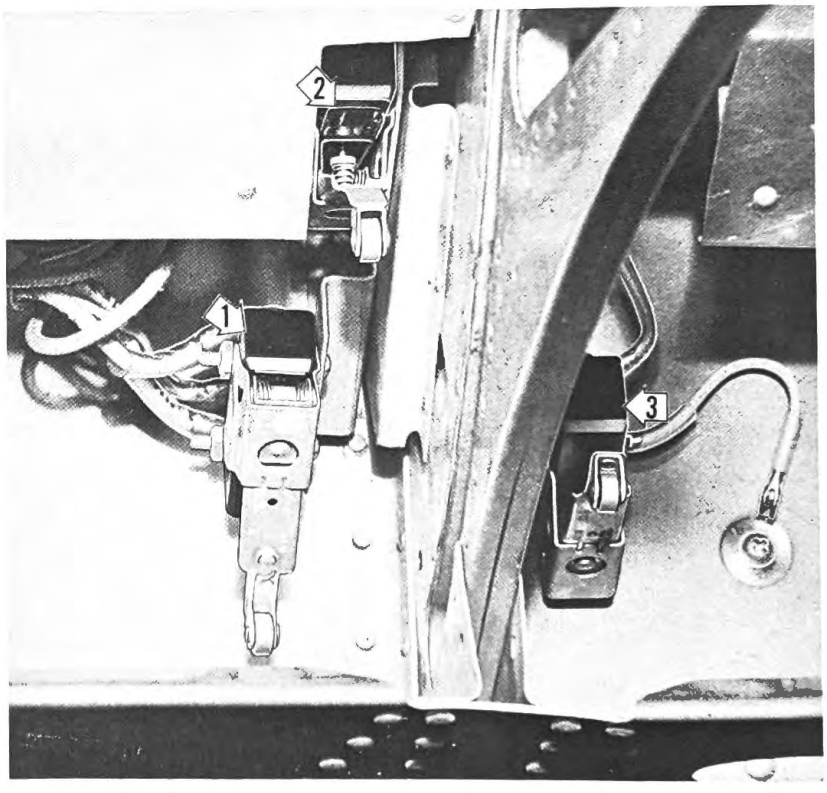


Figure 2-25. Flap Assembly




1. Up Limit Switch
2. Down Limit Switch
3. Intermediate (20°) Switch

Figure 2-26. Flap Limit Switches

2.9.6.3 Down-Limit Switch -
The landing gear down-limit switch is located on the right side of the limit-switch bracket on the front spar adjacent to the landing gear motor. It opens the circuit to the landing gear motor when down and locked position is reached.

2.9.6.3.1 Trouble Shooting -
See Chart 2-3, Trouble Shooting, Limit Switches and Safety Switch.

2.9.6.3.2 Adjustment -
(a) Jack airplane and support tail section.
(b) With gear down and locked, adjust down-limit switch with hexagonal mounting nuts so that plunger is depressed 1/16 inch beyond point where switch clicks.
(c) Completely retract gear and again extend it without stopping in an intermediate position.
(d) Make fine adjustments with above mounting nuts, if necessary, to compensate for slight "coast" and backlash of system. Switch should cause actuator to stop when actuator shock spring is compressed approximately 1/8 inch.

2.9.6.4 Down-Lock Position and Warning Switches -
Both a normally closed and a normally open Micro switch are installed at the knee of each of the three landing gear drag braces. The right position switches on all three drag braces are wired in series to the green "L.G. Down" position indicator light. Therefore, this light will not come on until all three braces are locked in the down position. The left warning switches on all three drag braces are wired in parallel with each other and in series with the throttle warning-horn switches. Therefore, if one or more of the drag braces is not locked in the down position while either engine is throttled back, the warning horn will sound.

2.9.6.4.1 Trouble Shooting -
See Chart 2-4, Trouble Shooting, Down-Lock Position Indicator Switches, or Chart 2-5, Trouble Shooting, Warning Horn, as applicable.

2.9.6.4.2 Adjustment -
(a) Jack airplane and support tail section.
(b) Insert six-inch scale between switches. Manually disengage down lock and slowly engage it again, observing where click occurs. Lower edge of switch housing should move approximately 7/32 inch after click, before reaching end of its travel.
(c) To adjust, remove safety wire from the two hexagonal mounting bolts and loosen slightly. Move switch in elongated holes until desired action is attained, tighten bolts and safety.
(d) Test retraction system for proper operation of horn and light through at least one complete cycle.

2.9.6.5 Landing Gear Safety Switch -
The landing gear safety switch is located on the right shock strut to prevent accidental retraction while the airplane is on the ground. The landing gear safety switch is set to remain open while the struts are at their normal extension with the weight of the airplane on the struts. It must be set to close the circuit at a point somewhat less than the full extended position of the struts, if reliable gear retraction is to be assured.

The landing gear switch is double-acting, completing the circuit to the warning horn if the landing gear switch is placed in the UP position with the shock strut compressed and completing the circuit to the landing gear motor when the switch is placed in the UP position with the shock strut extended.

The safety switch is intended to protect against accidental retraction only while the airplane is at rest or moving slowly. If the switch is in the UP position and the airplane rolls across a depression in the runway fast enough for the wing to lift, or a sudden gust of wind lifts the airplane a few inches, the landing gear will retract.

2.9.6.5.1 Trouble Shooting -
See Chart 2-3, Trouble Shooting, Limit Switches and Safety Switch.

2.9.6.5.2 Adjustment -
(a) Jack airplane and support tail section.
(b) Place a small jack under shock strut and raise until shock absorber is compressed 3/4 inch.
(c) Loosen switch mounting clamp, adjust to position where actuator barely clicks switch and secure clamp.
(d) Raise small jack, then lower it carefully to point where switch clicks again. Mark this location of shock strut and remove jack. Mark should indicate 3/4-inch extension of strut after switch clicks.

2.9.6.6 Throttle Warning-Horn Switch -
A cam-operated switch is attached to the linkage of each throttle behind the instrument panel. The switches are interconnected so that closing of either or both throttles beyond a safe flight setting with the gear retracted will sound the warning horn. A flasher in the circuit produces intermittent operation of the horn, making it more easily distinguished from the continuous-sounding stall warning horn.

2.9.6.6.1 Trouble Shooting -
See Chart 2-5, Trouble Shooting, Warning Horn and Switches.

2.9.6.6.2 Adjustment -
(a) Set parking brake, chock wheels and start engines.
(b) Advance throttles until manifold pressure gage registers 10 inches Hg. with propellers in low pitch.
(c) Move mixture controls to Idle Cutoff position and stop engines, leaving throttles in the same position.
(d) Adjust threaded linkage behind instrument panel until cams click switches closed.
(e) Make flight test to determine if warning system functions properly.

CHART 2-1. BRAKE TROUBLE SHOOTING

| TROUBLE | PROBABLE CAUSE | CORRECTIVE ACTION |
|---|---|---|
| 1. Solid pedal and no brakes. | a. Brake lining worn beyond allowable limit. | a. Replace lining. |
| 2. Spongy brake. | a. Air in system. | a. Bleed brakes as outlined in Paragraph 2.9.3.9. |
| 3. Unable to hold pressure. | a. Leak in brake system. | a. Visually check entire system for evidence of leaks.<br>b. Check master cylinder seals; replace if scored. |
| 4. Parking brake will not hold. | a. Air in system. | a. Bleed system as outlined in Paragraph 2.9.3.9. |
| | b. Defective parking brake valve. | b. Replace the valve. |
| 5. Brakes grab. | a. Stones or foreign matter locking brake disc.<br>b. Warped or bent disc. | a. Clean brake disc and lining.<br>b. Replace disc. |

CHART 2-2. TROUBLE SHOOTING, LANDING GEAR AND SWITCH

| TROUBLE | PROBABLE CAUSE | CORRECTIVE ACTION |
|---|---|---|
| 1. Landing gear will not retract or lower. | a. Circuit breaker tripped in control or motor circuit. | a. Reset. |
| | b. Loose motor ground connection. | b. Clean and tighten. |
| | c. Open circuit. | c. Test continuity:<br>(1) Control circuit breakers landing gear switch.<br>(2) Main belly terminal post to motor circuit breaker and dynamic brake relay(Terminal 3). |
| 2. Landing gear will lower but not retract. | a. Open circuit between landing gear switch and dynamic brake relay. | a. Test continuity from up terminal of landing gear switch and energizing wire terminal of the up solenoid switch (Terminal C-1). |
| | b. Up solenoid switch inoperative. | b. Check solenoid for operation. |
| | c. Open circuit between dynamic brake relay and up winding in motor. | c. Test continuity from up solenoid power terminal to up winding of motor (Terminal 1 of dynamic brake relay). |
| 3. Landing gear will retract but not lower. | a. Open circuit. | a. Test continuity from down terminal of landing gear switch to down limit switch and energizing wire terminal of the down solenoid (Terminal C-2 on the dynamic brake relay). |
| | b. Down solenoid inoperative. | b. Check down solenoid for operation. |

CHART 2-2 (CONT)

| TROUBLE | PROBABLE CAUSE | CORRECTIVE ACTION |
|---|---|---|
| | c. Open circuit between dynamic brake relay and down winding of motor. | c. Test continuity from down solenoid power terminal to down winding of motor (Terminal 2 of dynamic brake relay). |
| 4. Circuit breaker tripping in energizing circuit. | a. Grounded circuit. | a. Test for ground:<br>(1) Between circuit breaker and landing gear switch.<br>(2) Between landing gear switch and solenoid on side (up or down) of energizing circuit that is tripping circuit breaker. |
| 5. Circuit breaker tripping in motor circuit. | a. Grounded circuit. | a. Test for ground:<br>(1) Between main belly post and dynamic brake relay (Terminal 3).<br>(2) In motor leads (with leads disconnected from motor). |
| | b. Mechanical defect in gear causing overload. | b. Check system for binding, interference, etc. |

CHART 2-3. TROUBLE SHOOTING, LIMIT SWITCHES AND SAFETY SWITCH

| TROUBLE | PROBABLE CAUSE | CORRECTIVE ACTION |
|---|---|---|
| 1. Landing gear motor fails to shut off when gear is retracted and "UP" light stays off. | a. Up limit switch out of adjustment.<br>b. Defective up limit switch. | a. Readjust.<br>b. Check switch for operation. |
| 2. Landing gear fails to retract. | a. Safety switch not closing. | a. Readjust. |
| 3. Landing gear fails to retract. completely but "UP" light comes on. | a. Up limit switch operates early. | a. Readjust. |
| 4. Positive down locks do not fully engage. | a. Down limit switch opens early. | a. Readjust. |
| 5. Landing gear motor fails to shut off when gear is extended. | a. Down limit switch does not open.<br>b. Defective down limit switch. | a. Readjust.<br>b. Check switch for operation. |

CHART 2-4. TROUBLE SHOOTING, DOWN AND LOCK POSITION INDICATOR SWITCHES

| TROUBLE | PROBABLE CAUSE | CORRECTIVE ACTION |
|---|---|---|
| 1. "L.G. Down" light inoperative. | a. Landing gear indicator circuit breaker tripped. | a. Reset. |
| | b. Defective bulb or holder. | b. Test both. |
| | c. Defective down lock position switch. | c. Check operation of all three switches. |
| | d. Open circuit. | d. Check continuity: Circuit breaker to light, nose, RH, LH gear down lock position switches, and ground. |

CHART 2-4 (CONT)

| TROUBLE | PROBABLE CAUSE | CORRECTIVE ACTION |
|---|---|---|
| 2. "L.G. Down" light stays on. | a. Grounded circuit. | a. Check for ground between light and nose gear down lock position switch. |
| 3. Circuit breaker tripping. | a. Grounded circuit. | a. Check for ground between circuit breaker and light. |

CHART 2-5. TROUBLE SHOOTING, WARNING HORN AND SWITCHES

| TROUBLE | PROBABLE CAUSE | CORRECTIVE ACTION |
|---|---|---|
| 1. Warning horn inoperative or malfunctioning. | a. Horn circuit breaker tripped. | a. Reset. |
| | b. Open or grounded circuit. | b. Check continuity:<br>(1) Circuit breaker to horn throttle switches, LH gear down lock warning switch, and ground.<br>(2) From throttle switches to nose gear down lock warning switch and ground.<br>(3) From throttle switches to RH gear down lock warning switch and ground. |
| | c. Throttle switches defective or out of adjustment. | c. Check and adjust if necessary. |
| | d. Main or nose gear down lock warning switches defective or out of adjustment. | d. Check and adjust if necessary. |
| | e. Flasher stuck open. | e. Check flasher continuity. |
| 2. Circuit breaker tripping. | a. Grounded circuit. | a. Check for ground between circuit breaker and warning horn. |

PART III
UTILITY SYSTEMS

## 3.1 DESCRIPTION

This section covers the maintenance, trouble shooting and repair of special systems installed for the comfort and safety of the occupants, or systems to be employed only under special conditions. Covered herein are the heating and defrosting system, ventilating system, the assist step mechanism and nose wheel steering system.

## 3.2 HEATING AND VENTILATING SYSTEM

3.2.1 Description -

Air for the heating and ventilating system of the B-50 is taken in through an opening in the fuselage nose. An iris valve, immediately back of the intake opening, is operated from the cabin to regulate the volume of incoming air. For ground operation, an electrically-driven blower is mounted in the intake duct, to the right of the nose wheel well. From the blower, air is ducted through a 50,000 BTU heater. Cold air for the front cabin outlet is bled from the blower adapter case. Just ahead of the heater, cold air is bled off and ducted to three rear seat outlets, two in the left and one in the right cabin walls. The heater is mounted beneath the floor panel of the nose baggage compartment, to the right of the nose wheel well. Hot air from the heater enters a plenum on the aft wall of the baggage compartment, then is ducted to the windshield defroster outlets and an outlet for each seat. The outlet for the rear seat is to the right of center of the front seat base, the front seat outlet is on the bulkhead between the cabin and nose baggage compartment, opening directly into the plenum.

3.2.1.1 Heater and Fuel System -

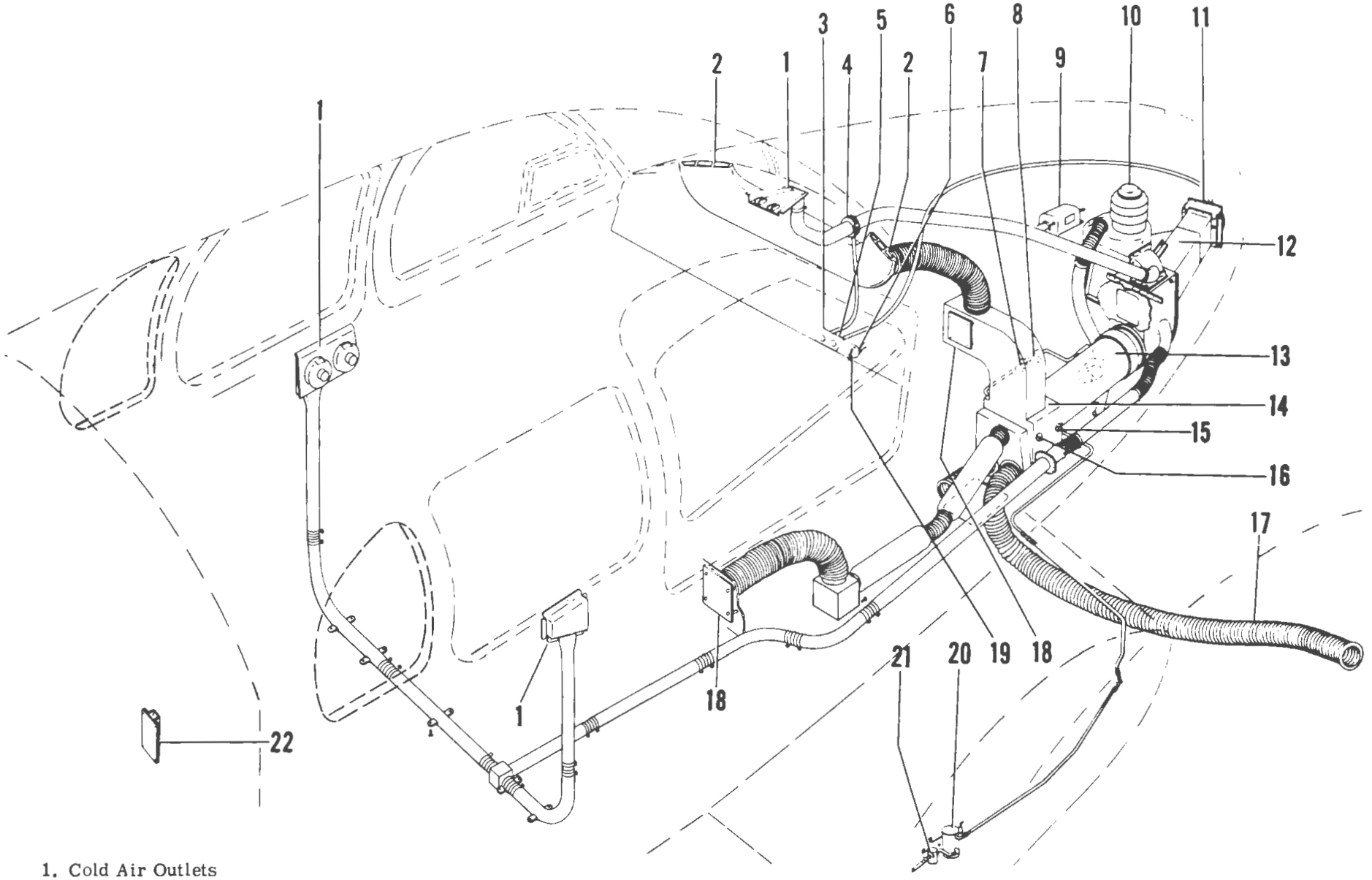
The heater, located in the lower right nose baggage compartment, is essentially a cylindrical combustion chamber within a hollow radiator and surrounded by a jacket. Incoming ventilation air passes between the combustion chamber and the radiator, and between the radiator and the jacket, in a straight line for the full length of the heater. Fuel is sprayed from a nozzle at one end of the combustion chamber and ignited by a spark plug which operates continuously whenever the heater is in use. Combustion air, bled from the blower adapter is forced into the chamber at a tangent and mixed with the fuel spray, producing a swirling flame. The flame travels the full length of the combustion chamber and the hot gases are ducted to the radiator where they again travel the full length of the heater before being exhausted overboard. Fuel is supplied to the heater from the right main wing tank, by an electric fuel pump mounted in the right wheel well. Fuel flow is shut off by two solenoid valves, one in the right wheel well and the other in the nose wheel well. The heater spark plug receives high voltage current from an ignition unit mounted on the left side of the nose wheel well. The ignition unit consists of a high-tension coil, similar to an automobile ignition coil, a condenser and a vibrator with two sets of contacts. A push-pull switch on the unit, normally safety-wired to the "IN" position may be pulled out, while on the ground, to place the alternate contacts in service if the normal contacts fail. The switch should be safety wired so that the normal contacts are in service.

3.2.1.2 Thermostats and Controls -

Cabin temperature is controlled by a thermostat mounted on the aft bulkhead above the seat. This thermostat is adjusted within a range of 2 degree C (35 degrees F) and 30 degrees C (85 degrees F) by a rheostat mounted on the right subpanel. Signals from the cabin thermostat operate a relay mounted on the generator control box, through which the heater igniter, heater fuel pump and the normally-closed heater fuel valves are energized. A second thermostat is connected in series with the cabin thermostat; installed in the heater plenum, this thermostat prevents excessively-hot air from entering the ducts by shutting off the heater whenever the plenum temperature reaches 66 degrees C (150 degrees F). Another thermostat in the intake duct, also in series with the cabin thermostat, was removed by Service Bulletin No. 9, which also added a switch to the cabin thermostat control rheostat. This switch permits turning the heater on or off as desired, although the control circuit itself is energized whenever the battery and heater and blower circuit breaker switches are on. The action of the 150 degree thermostat results in the intermittent operation, or cycling, of the heater as a normal function; the duration and frequency of the cycles will vary with the outside air temperature. A second thermostat in the plenum is connected through a resistor to the heater system fuse on the generator control box. If, through a malfunction, the temperature in the plenum should rise to 149 degrees C (300 degrees F) this thermostat will close and ground the fuse, which opens all heater circuits.

Both the heater and the static air blower are controlled by a toggle switch circuit breaker on the right subpanel. In normal operation, this switch is left "ON" at all times. The blower, intended for ground operation only, is controlled by a switch actuated by the same lever as the landing gear control switch; thus, when the gear is raised on take-off, the blower is switched off simultaneously. In flight, ram air alone is sufficient for heating and ventilation. An additional switch, on the ventilation air valve control turns off both the blower and the heater when the control is pulled out more than halfway.

Cold air for the rear seat is regulated by rotating the covers on the three individual duct openings. A push-pull control on the right subpanel operates an iris valve in the duct behind the instrument panel to regulate the cold air supply to the front seat. No individual controls are provided for the cabin heat.




1. Cold Air Outlets
2. Defrosters
3. Front Seat Cold Air Control
4. Front Seat Cold Air Valve
5. Ventilation Air Valve Control
6. Circuit Breaker Switch
7. Fuel Strainer
8. Fuel Shut-Off Valve
9. Ignition Unit
10. Blower
11. Ventilation Air Valve
12. Air Inlet Thermostat*
13. Heater
14. Plenum
15. Overheat Thermostat
16. Cycling Thermostat
17. Engine Preheat Duct (Optional Equipment)
18. Cabin Heat Outlets
19. Temperature Control Rheostat
20. Heater Fuel Pump
21. Shut-Off Valve
22. Cabin Thermostat

Figure 3-1. Heating and Ventilating System

*Removed by Service Bulletin No. 9

3.2.2. Removal of Ventilation Air Valve -
(a) Remove screws holding nose cone to fuselage and pull cone off.
(b) Remove screws attaching valve and inlet screen to duct and remove screen.
(c) Disconnect control wire and remove valve.

NOTE

Before disconnecting control wire, the control should be placed in either the full-open or full-closed position, so it may be reinstalled without disturbing the adjustment of the blower switch.

3.2.3 Cleaning and Lubrication -
The iris-type ventilation air valve should be cleaned as necessary and lubricated with powdered graphite. Oil should not be used on the valve.

3.2.4 Installation of Ventilation Air Valve -
(a) Place valve in position and insert screws temporarily.
(b) Connect control wire to actuator arm.
(c) Remove screw, place screen in position over valve and replace screws.
(d) Reinstall nose cone.

3.2.5 Trouble Shooting, Cabin Air Blower -
Most difficulties with the static air blower may be traced to maladjustment of one of the two control switches, loose connections or worn motor brushes. If motor does not run, check switch adjustment by actuating switches manually. Check circuit continuity and tightness of connections.

3.2.6 Removal of Cabin Air Blower -
(a) Place a suitable jack under the nose jack point and raise the airplane until the nose wheel clears the ground.

CAUTION

When jacking the nose, place a stand under the tail; with the nose wheel clear ( shock strut extended) the aircraft approaches a tail-heavy condition.

(b) Disconnect the drag leg lower brace from the nose gear and the retract link from the actuator; let the drag leg brace assembly swing back against the bulkhead.
(c) Working from the nose wheel well, remove the screws securing the blower adapter to the intake duct.
(d) In the nose baggage compartment, loosen the forward clamp on the cold air duct to the front seat.
(e) Pull the blower and adapter away from the duct and lower into the wheel well to gain access to the clamps on the combustion air flexible duct and the electrical leads to the blower motor.
(f) Disconnect the duct and electrical leads and remove blower.

3.2.7 Disassembly of Blower -
(a) Remove the screws securing the blower to the adapter and lift blower and scroll from the adapter.
(b) Remove the setscrew from the hub of the ventilation rotor and pull rotor from shaft.

CAUTION

The ventilation rotor is balanced to close tolerance by placing bits of solder on the vanes. Always handle this rotor by its hub, never by the vanes, and protect the vanes from becoming bent or otherwise damaged.

(c) Remove screws holding the combustion blower pan to the blower scroll and lift motor, pan and combustion rotor from scroll.
(d) Drive out Rollpin holding combustion air rotor to motor shaft and pull rotor from shaft.
(e) Cut safety wire and remove bolts holding pan to end bell of motor. Remove pan from motor.

3.2.8 Minor Repairs and Parts Replacement -
Due to the high operating speed of the blower, balance of the rotors is critical. No repairs such as straightening bent rotor blades should be attempted. If the blower vibrates excessively, the rotors should be replaced. The motor bearings are sealed and require no lubrication. Motor brushes may be replaced by unscrewing the Bakelite plugs in the upper end bell and withdrawing the brush springs. Minimum brush length should be approximately 3/8 inch.

3.2.9 Reassembly of Blower -
(a) Place combustion air blower pan on motor and install bolts. Safety.
(b) Place combustion air rotor on motor shaft and install Rollpin.
(c) Install motor and pan on blower scroll.
(d) Install ventilation rotor on motor shaft, maintaining a clearance of 1/16 inch between rotor and upper end plate. Tighten setscrew firmly.

CAUTION

Handle ventilation rotor by its hub only. Take care not to bend blades or dislodge solder on tips of blades; bending the blades or dislodging the solder will destroy the rotor balance.

(e) Place blower on adapter, securing with screws.

3.2.10 Installation of Cabin Air Blower
(a) Connect rotor electrical leads and combustion air duct.
(b) Insert front cockpit cold air duct through hole in baggage compartment bulkhead and put blower and adapter in position on air intake duct.
(c) Install screws attaching adapter to duct.
(d) Reconnect landing gear retract link to actuator and drag leg lower brace to nose gear.

3.2.11 Trouble Shooting, Heater System -
For trouble shooting, heater system see Chart 3-1.

3.2.12 Heater Removal -
(a) Remove access cover in lower outboard side of forward bulkhead in nose baggage compartment.
(b) Disconnect spark plug lead from heater.
(c) Remove floor panel over heater.
(d) Remove the two floor supports above the heater.
(e) Disconnect fuel inlet line at valve in nose wheel well and pull through grommet.
(f) Unfasten rubber drain line from right side of nose wheel well and remove cover plate through which it protrudes.
(g) Disconnect flexible combustion air tube from heater.
(h) Disconnect metal drain line from bottom of heater.
(i) Unfasten clamps and remove heater.

3.2.13 Minor Repairs and Parts Replacement, Heater -
Minor repairs of the heater will consist of replacement of broken or worn high-tension lead, spark plug, fuel line fittings, or fuel nozzle. The fuel nozzle may be cleaned with an approved solvent. If evidence of corrosion is found, the entire nozzle should be replaced. When assembling the heater, all male threads should be coated with anti-seize compound, Specification AN-C-53.

CAUTION

In cleaning the fuel nozzle, do not use a metallic tool or abrasive, since the flow characteristics of the nozzle may be altered. A sharpened toothpick is recommended for cleaning the orifice and the grooves in the nozzle core.

3.2.14 Minor Repairs and Parts Replacement, Heater Ignition -
Repair of loose or broken external connections only should be attempted in the field. The vibrator contact switch is safety-wired at the in position, placing the normal vibrator contacts in service, on installation of the unit. If the wire is broken and the switch pulled out, the reserve contacts are in service. On installation of a new vibrator, the switch should again be safety wired with the normal contacts in service. If replacement of the vibrator does not restore normal function of the unit, the entire unit should be replaced.

CAUTION

In cleaning the ignition unit or wiring, do not use carbon tetrachloride, trichloroethylene, or other chlorinated solvents.

3.2.15 Heater Installation -
(a) Align exhaust outlet and insert heater in mounting position.
(b) Fasten heater mounting clamps, making sure that clamps seat properly over beads in order to obtain a good seal. Safety clamps.
(c) Attach metal drain line.
(d) Attach flexible air tube.
(e) Insert rubber drain line through cover plate and fasten cover and line as removed.
(f) Insert fuel inlet line through grommet and attach to valve in nose wheel well.
(g) Install floor supports and floor panel.
(h) Connect lead to spark plug.
(i) Install spark plug access cover.

## 3.3 ENGINE PREHEAT SYSTEM

The engine preheat system is not installed in the airplane as it comes from the factory but may be installed as optional equipment. The engine preheat system consists of two insulated flexible hoses, running from the plenum chamber in the lower right side of the nose section, to each nacelle. These flexible hoses are fitted with quick disconnect connections and plug into the inboard side of each nacelle. They are stowed in the belly, beside the heater plenum, when not in use.

3.3.1 Operational Procedure -

NOTE

External power should be used to operate the engine preheater, since the batteries have insufficient capacity to operate the heater over a prolonged period and still start the engines.

(a) Open access door in belly, beneath nose baggage compartment, to gain access to the flexible hose.
(b) Remove free end of flexible hose and plug into access door in the inboard lower side of each nacelle.
(c) Operate cabin heater.

NOTE

As there is no separate thermostat to control the heat in the engine compartments, for extreme cold weather starting turn the cabin thermostat to the highest setting to allow the maximum heat to enter the engine compartment. Cabin door and windows must be closed.

## 3.4 ASSIST STEP MECHANISM

3.4.1 Description -
An assist step for boarding the airplane automatically lowers when landing gear struts are compressed on landing and retracts when struts extend on takeoff. A micro switch, in the same housing as the landing gear safety switch and operated by the same plunger, controls the system, while up and

down limit switches in the assist-step well stop the drive motor at both extremes of travel. The actuator is of the jackscrew type; mechanical linkage from the step opens and closes the fairing door.

3.4.2 Trouble Shooting -
See Chart 3-2, Trouble Shooting, Assist Step.

3.4.3 Removal -
(a) Disconnect door linkage by removing one of the attachment bolts.
(b) Remove bolt connecting actuator to step.
(c) Drive out the two outboard Rollpins with pin punch.
(d) Remove the bolts attaching outboard support to side of fuselage.
(e) Telescope outboard bushing in step pivot shaft and remove step.
(f) Remove front floorboard of rear baggage compartment and upholstery panel just forward of door.
(g) Remove boot clamp and disconnect cannon plug.
(h) Remove the two mounting bolts and remove actuator-motor assembly.

3.4.4 Installation -
(a) Insert actuator-motor assembly, install mounting bolts and safety.
(b) Install boot clamp and connect cannon plug.
(c) Mount step assembly and outboard support, installing the mounting bolts.
(d) Slide bushing into place and install Rollpins.
(e) Install bolt connecting actuator to step.
(f) Install bolt connecting door linkage.
(g) Jack airplane, support tail, and test retraction of step through one complete cycle.
(h) Install floorboard and upholstery panel.

3.4.5 Adjustment -
(a) Adjust down-limit (aft) switch to stop step extension just as head of stop bolt hits positive down stop.
(b) Adjust up-limit (forward) switch to stop step retraction just as door fully closes.

## 3.5 NOSE-STEERING MECHANISM

The steerable nose wheel is connected to the rudder pedals through a system of push-pull tubes and hinge-joints. A spring-loaded link in the system absorbs steering shocks which would otherwise be transferred to the rudder pedals. An automatic centering device assures proper wheel alignment for retraction.

3.5.1 Removal -
(a) Turn nose wheel to full left turn position.
(b) Remove forward (shock) link.
(c) Remove nose cone.
(d) Remove scissors links and yoke.
(e) Remove pilot's floorboards.
(f) Remove aft link and idler arm.

3.5.2 Installation and Adjustment -
(a) Install scissors links, yoke and idler arm.
(b) Install fore and aft links adjusting to proper length with nose wheel and rudder pedals centered.
(c) Test system for binding through entire possible travel.
(d) Install floorboards and nose cone.

CHART 3-1. TROUBLE SHOOTING, HEATER SYSTEM

| TROUBLE | PROBABLE CAUSE | CORRECTION |
|---|---|---|
| 1. Blower runs but heater will not start. | (a) Blown fuse. | (a) Check for malfunction or grounded lead between safety thermostat and fuse. |
| | (b) Faulty ignition unit, vibrator. | (b) Switch to reserve vibrator contacts. If this corrects trouble, replace vibrator at first opportunity. |
| | (c) Fuel pump inoperative. | (c) Disconnect discharge line from fuel pump and check for flow. Replace defective pump. |
| | (d) One or both fuel valves inoperative. | (d) Disconnect fuel line and check for fuel flow; check valve in nacelle first. Replace defective valve. |
| | (e) Faulty ignition unit coil. | (e) Remove lead from spark plug and hold so spark may jump to structure. If no spark, replace ignition unit. |
| | (f) Fouled or defective spark plug. | (f) If test in (e) above produces spark, remove and clean or replace spark plug. |
| | (g) Defective cabin thermostat or rheostat. | (g) Disconnect thermostats in cold air duct and plenum and tape their leads together. Disconnect cabin thermostat leads; heater should start. Touch leads together; heater should stop. Check rheostat for continuity and voltage drop. Check wiring for grounded leads. |
| | (h) Defective thermostat in cold air duct. (unless removed per Service Bulletin No. 9). | (h) With cabin thermostat turned up, disconnect leads from thermostat in cold air duct; touch leads together. If heater comes on, thermostat is defective. |
| | (i) Defective cycling thermostat in plenum. | (i) Repeat procedure in (h) above, for cycling thermostat. |
| | (j) Fuel strainer clogged. | (j) Clean strainer. |
| | (k) Fuel nozzle clogged or loose. | (k) Remove and clean fuel nozzle. Be sure nozzle core is seated tightly. |
| 2. Neither heater nor blower will operate. | (a) Circuit breaker tripped. | (a) Reset circuit breaker switch. |
| | (b) Open circuit. | (b) Check continuity, right subpanel bus to circuit breaker switch. |
| 3. Heater backfires intermittently. | (a) Loose connections in control circuit, loose high-tension lead to spark plug. | (a) Check connections, check wiring breaks. |
| | (b) Mixture too rich. | (b) Make checks in item 4 below. |
| 4. Fuel mixture too rich; exhaust smudges fuselage. | (a) Restriction in combustion air duct. | (a) Check air intake valve. Check ducts for obstructions. |
| | (b) Restriction in exhaust duct. | (b) Check exhaust outlet. |

CHART 3-1. TROUBLE SHOOTING, HEATER SYSTEM. (CONT'D)

| | | |
|---|---|---|
| | (c) Loose core in fuel nozzle. | (c) Clean nozzle. Make sure core is seated tightly in shell. |

CHART 3-2. TROUBLE SHOOTING, ASSIST STEP

| TROUBLE | PROBABLE CAUSE | CORRECTION |
|---|---|---|
| 1. Step fails to retract or extend. | (a) Circuit breaker tripped. | (a) Reset. |
| | (b) Open Circuit | (b) Check continuity:<br>1. Step circuit breaker to strut switch.<br>2. Motor to ground. |
| | (c) Defective strut switch | (c) Check switch operation. |
| 2. Circuit breaker keeps tripping. | (a) Grounded circuit. | (a) Check for ground:<br>1. Circuit breaker to strut switch.<br>2. Strut switch through up or down circuit as applicable. |
| | (b) Limit switch not breaking circuit. | (b) Check and readjust if necessary. |

CHART 3-3. TROUBLE SHOOTING, STALL WARNING SYSTEM.

| TROUBLE | PROBABLE CAUSE | CORRECTION |
|---|---|---|
| 1. Warning system inoperative. | (a) Warning circuit breaker tripped. | (a) Reset. |
| | (b) Open circuit. | (b) Check continuity:<br>1. Circuit breaker to indicator.<br>2. Indicators to switch.<br>3. Switch to ground. |
| | (c) Defective switch. | (c) Check switch operation. |
| | (d) Defective indicators. | (d) Check for operation. |
| 2. Indicators stay on. | (a) Grounded circuit between indicators and switch. | (a) Test for ground. |
| | (b) Defective switch. | (b) Check switch operation. |

PART IV
POWER PLANT

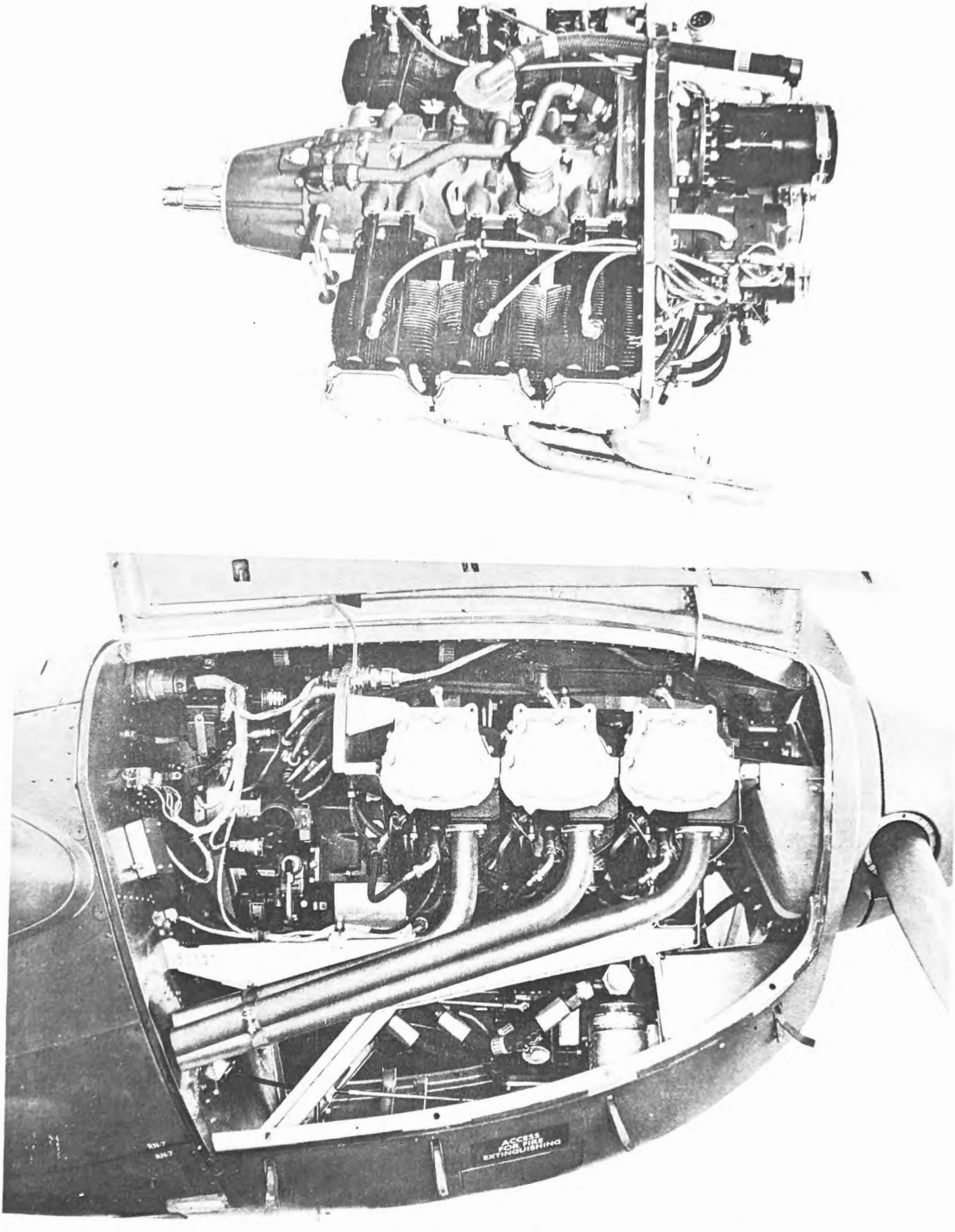



Figure 4-1. Power Plant

4.1 DESCRIPTION -

The Model B-50 is powered by two Lycoming GO-435-C2, air-cooled wet sump, horizontally-opposed six-cylinder engines. These engines develop 260 hp at 3400 rpm for take-off. Maximum cruising horsepower is 245 developed at 3100 rpm. The crankshaft is geared to the propeller through a planetary gear arrangement that results in a propeller to engine ratio of 77 to 120.

The power plant installation utilizes a jet augmenter exhaust system to assure adequate cooling and provide added thrust.

The entire engine package is designed to be completely interchangeable, left to right or from one airplane to another.

4.2 ENGINE -

4.2.1 Removal -

(a) Remove the propeller as outlined in Paragraph 4.4.1.2.
(b) Remove the cowling as outlined in Paragraph 4.3.1.1.
(c) Disconnect the engine and propeller controls at the engine.
(d) Remove electrical connectors at the firewall.
(e) Disconnect magneto leads at the magneto.
(f) Disconnect fuel, oil, and vacuum lines at the firewall.
(g) Disconnect tachometer connection at the engine.
(h) Attach hoist to engine lifting eyes. Minimum hoist capacity should be 1000 pounds.
(i) Remove four engine mount attaching bolts from the nacelle firewall.
(j) Lift engine clear of the airplane.

4.2.2 Engine Change -

When an engine is removed from the airplane and a new engine is to be installed, the following accessories and adapting parts which are not furnished with the new engine must be installed:

1. Baffles.
2. Propeller governor.
3. Carburetor air scoop.
4. Vacuum pump.
5. Propeller motor.
6. Tachometer generator and tachometer drive.
7. Generator.
8. Starter.
9. Exhaust pipes.
10. Oil drain fitting.
11. Engine bonding straps.
12. External oil fittings.

4.2.3 Installation -

(a) Lift engine into position and install bolts attaching the engine mount to the nacelle firewall.
(b) Connect magneto ground wires to magneto.
(c) Connect tachometer electrical plug to engine.
(d) Connect firewall electrical connectors.
(e) Connect fuel, oil, and vacuum lines.
(f) Connect and rig all engine and propeller controls to assure full travel and proper synchronization with the controls of other engines.
(g) Install engine cowling as outlined in Paragraph 4.3.1.3.
(h) Install propeller as outlined in Paragraph 4.4.1.3.
(i) Fill crankcase with correct grade of engine oil as indicated in Paragraph 1.3.2.
(j) Operate engine and check all controls for proper operation at various power settings; check engine idle adjustment. After engine operational check, inspect engine compartment for evidence of oil leaks.

NOTE

If for some reason you wish to start the engine with the upper cowling removed, it is permissible to do so. However, extreme caution should be used to run the engine for any period of time with the upper cowling removed as the engine will not cool, nor will the engine cool with the upper cowling installed and open. Since the lower cowling is part of the structure, under no circumstances should the engine be started with it removed.

4.3 ENGINE COWLING -

4.3.1 Description -

The engine cowling is constructed with a large hinged section on each side of the engine. These sections are provided with quick-release fasteners to facilitate access for maintenance. Since these sections provide access to all of the engine components, it should not be necessary to remove the cowling except at engine change.

4.3.1.1 Removal -

(a) Make sure magneto switches are in the "OFF" position.
(b) Remove screws along top and bottom of the cowling at the nacelle firewall.
(c) Remove the bolts attaching the oil radiator to the cowling former.
(d) Disconnect the carburetor air duct from the carburetor air scoop.
(e) Disconnect the carburetor drain from the carburetor air scoop.
(f) Remove screws attaching the forward air inlet baffle to the lower cowling.
(g) Remove the two bolts on each side of the forward former that attach the upper cowling section to the lower cowling section.
(h) Remove upper cowling.
(i) Remove two bolts attaching lower cowling to the engine mount.
(j) Remove cowling.

4.3.1.2 Minor Repair and Parts Replacement -

Minor repair will be limited to replacement of cowling fasteners and patching of worn or damaged sections of skin. Some engine loads are transmitted through the cowling; hence, it should be considered a structural component and skin repairs should be made in accordance with accepted structural repair procedures.

4.3.1.3 Installation -

(a) Place lower cowling in position for installation and install two bolts attaching lower cowling to

the engine mount.
(b) Install upper cowling and install screws attaching front baffle to lower cowling.
(c) Install bolts in front cowling former that attach the upper and lower cowling section.
(d) Install screws in upper and lower cowling at nacelle firewall.
(e) Install bolts attaching the oil radiator to the cowling former.
(f) Install air intake duct on carburetor air intake.
(g) Connect carburetor drain to carburetor air scoop.

## 4.4 PROPELLER AND CONTROL SYSTEM.

### 4.4.1 General Description - 272-101 Propeller (Full Feathering) -

The Beech Model 272-101 propeller assembly consists of a propeller, transmission, employing a governor-controlled hydraulic motor for normal constant-speed operation and a manually controlled electric motor for quick feathering in an emergency. The hydraulic motor is mounted on the aft end of the transmission case while the electric motor is mounted on the side of the case. The transmission assembly is attached with two brackets to the nose section of the engine and the propeller mounts on the SAE 20 spline crankshaft of the Lycoming GO-435-C2 engine. The two large external gears on the propeller hub mesh with the two external gears of the transmission assembly. The transmission is interconnected to a Woodward governor on the left side of the engine accessory case by two steel oil lines and to a feathering and unfeathering relay on the firewall by an electrical wiring harness. A conventional lever on the pilot's console is linked to the governor and to a feathering switch on the firewall.

The governor pump boosts the engine oil pressure to approximately 500 psi and directs it to either the increase or decrease pitch side of the hydraulic pitch-change motor, as required, simultaneously directing spent oil from the opposite line back to the engine sump through the governor. Designed internal leakage from the hydraulic motor lubricates the transmission gear box and drains back to the engine sump through a separate line.

Forcing the propeller control lever past the safety detent to the extreme aft position actuates the feathering switch on the firewall which energizes the feathering field of the electric motor. The hydraulic motor assists the electric motor in the feathering direction until the oil pressure drops to an ineffective value at about 200 engine rpm. The linkage from the propeller control lever is so connected that the hydraulic feathering action precedes that of the electric feathering motor by a fraction of a second. As the feathering is completed, the feathering limit switch breaks the circuit, stopping the electric motor.

The hydraulic feathering action is made possible by mechanically pulling the governor pilot valve to the position where it will call for increased pitch, just as the governor flyweights do during an overspeed condition. The mechanical override has no effect on the governor operation in the normal constant speed range, but during the feathering process as engine speed decreases due to propeller pitch increase, the override continues to direct governor oil to the increase pitch side of the hydraulic motor, whereas, normal flyweight action would have directed this oil to the opposite side.

Moving the propeller control back into the normal operating range reverses the electric motor, moving the blades toward low pitch. At 45 degrees the unfeathering limit switch breaks the circuit, letting the governor and hydraulic motor take over control of the blade angle in the constant speed range. Since the feathering limit switch closes again as soon as the blades leave the feathered position, the electric motor stands ready throughout the blade-angle range to fully feather the propeller within 4 to 5 seconds.

Briefly, the transmission changes the pitch of the blades as follows: when the governor is in the On-speed condition (no pitch change is taking place) the two gears (3,4 figure 4-2) on the front of the transmission are turning at the same rpm, as are the two gears (1, 2) that they mesh with. When the governor is in an over-speed condition (or underspeed condition) oil pressure from the governor is directed to the hydraulic motor on the rear of the transmission. The oil motor drives the front gear (4) through a planetary gear system, which in turn drives a gear (5) for each blade, changing the pitch. The entire pitch change operation centers around the difference in number of teeth in the two gears inside the planetary system that drive the two gears (3, 4) on the front of the transmission.

#### 4.4.1.1 Trouble Shooting -

See Chart 4-1, Trouble Shooting 272-101 Propeller.

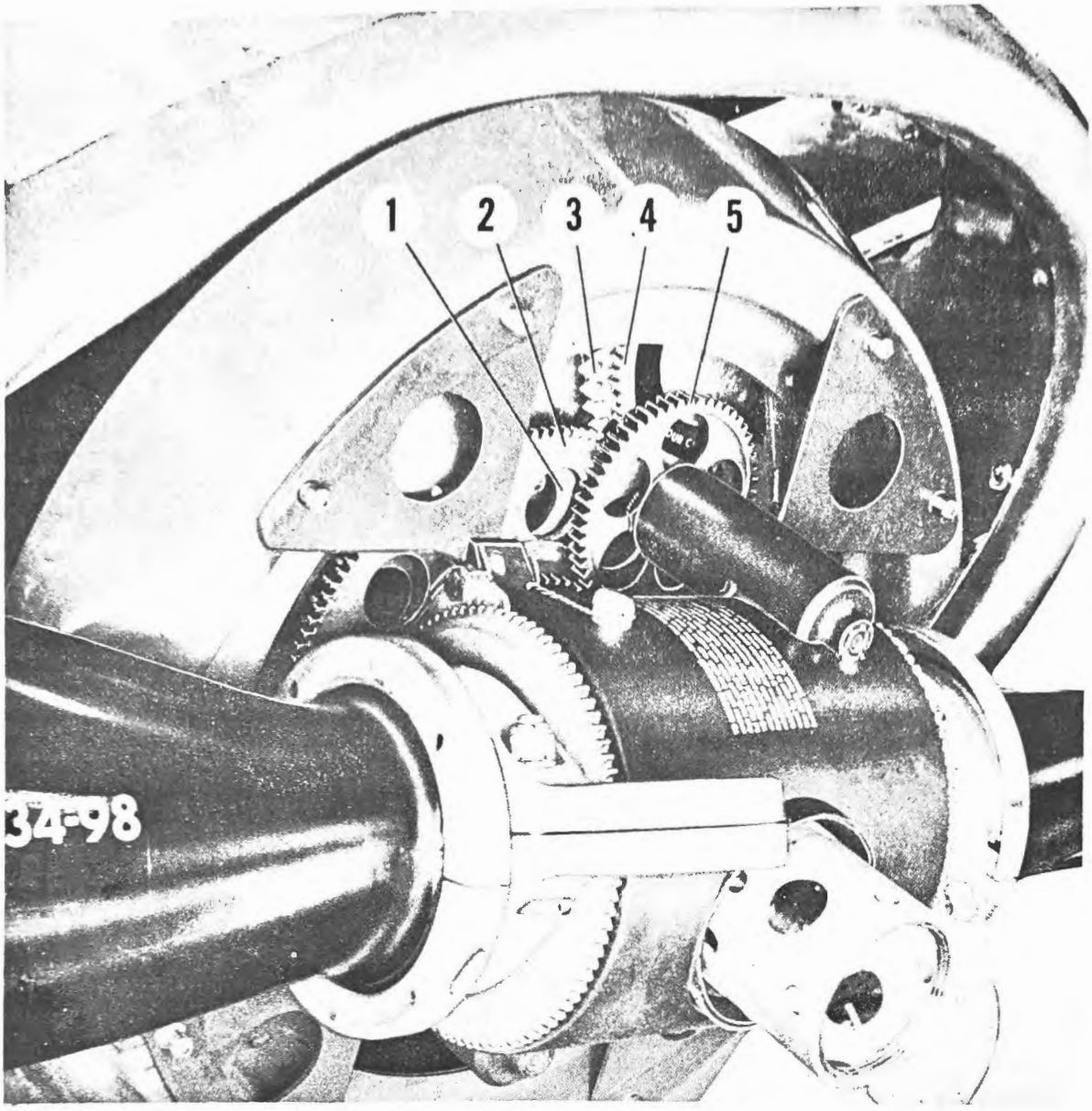
#### 4.4.1.2 Removal of Propeller -

Before beginning to remove the propeller, make sure the engines were stopped with the propeller in low pitch.

NOTE

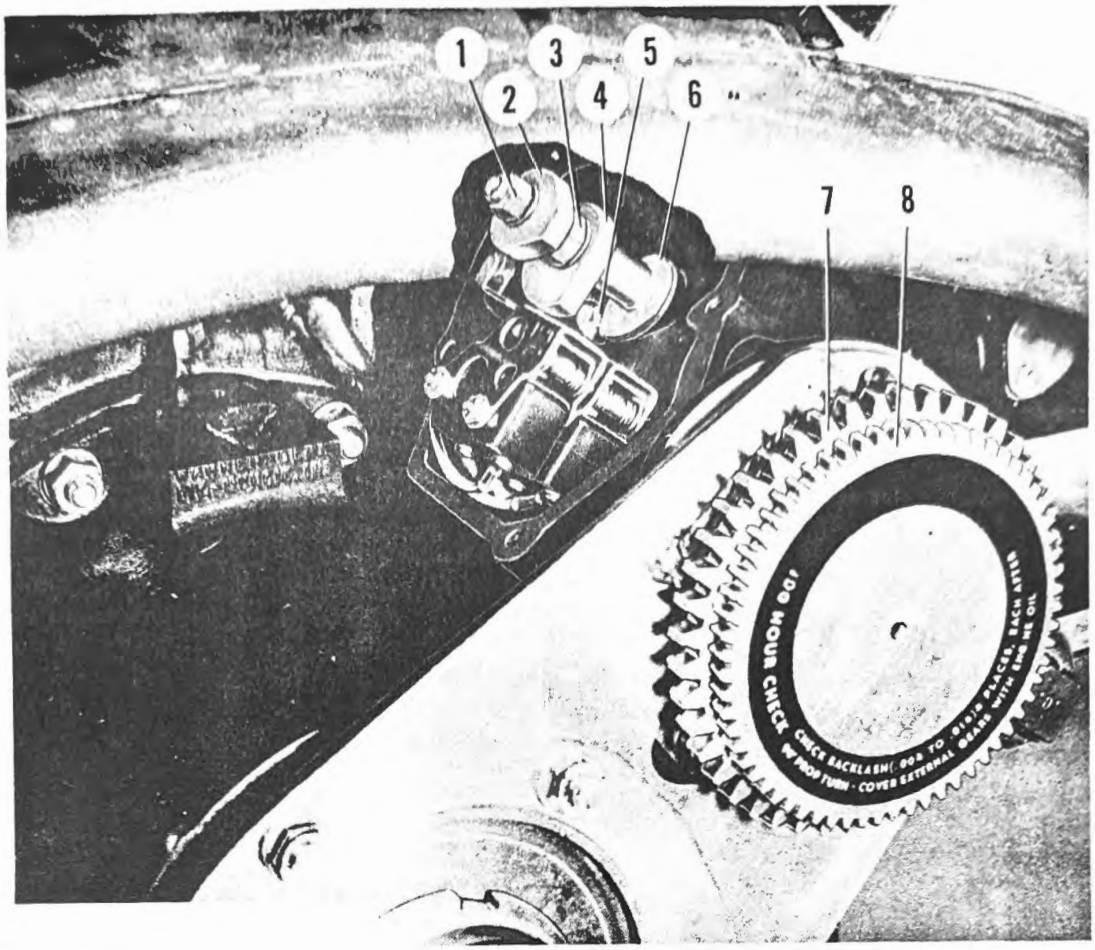
If the same propeller and transmission are to be reinstalled without disassembling either, considerable installation time and effort can be saved by marking the mating teeth of the two front gears (3, 4, figure 4-2) on the transmission and the larger gears (1,2) that they mesh with, before removing propeller. Use Blue Dykem or similar marking substance which will not easily rub off. Lock together the two front gears on the transmission and also the two larger propeller gears with safety wire to prevent changing their relationships.

(a) Remove cotter pin and nut from the spinner attaching bolt at point of spinner and remove spinner.
(b) Remove rubber cone and spacers from propeller retaining nut.
(c) Remove clevis pin and loosen the hub retaining nut.
(d) Tie the two external propeller gears together




1. Propeller Assembly Drive Gear
2. Propeller Assembly Pitch Change Gear
3. Transmission Drive Gear
4. Transmission Pitch Change Gear
5. Worm Drive Gear

**Figure 4-2. Propeller Pitch Change Mechanism**




1. Nut
2. Feathering Cam
3. Beveled Spacer
4. Unfeathering Cam
5. Low Pitch Valve
6. Low Pitch Cam
7. Transmission Drive Gear
8. Transmission Pitch Change Gear

Figure 4-3. Propeller Transmission

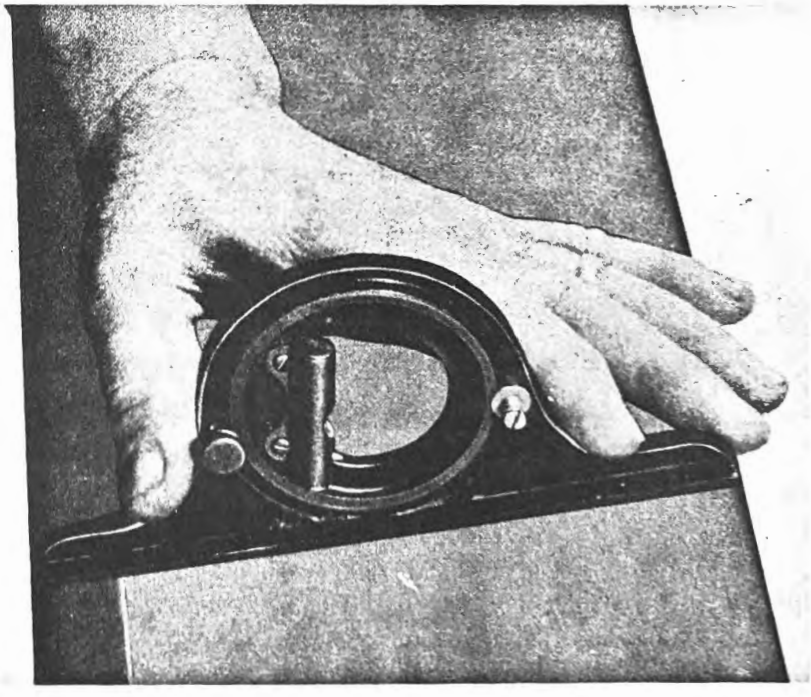


Figure 4-4. Propeller Low Pitch Check

with a safety wire. Also tie the two external transmission gears together with safety wire and tie safety wire to the large transmission mounting bracket. Wiring these gears together fixes the propeller low pitch setting and prevents the transmission gears from rotating relative to each other, which would lose the hydraulic low pitch stop setting.

(e) Carefully unscrew the hub retaining nut and remove the propeller, making sure the external gears mesh as they slide over one another.

4.4.1.2.1 Transmission Removal -

(a) Disconnect governor oil lines from the transmission oil motor and loosen the oil drain line on the lower side of the transmission.

(b) Disconnect the electrical harness at the engine rear baffle cannon plug connection.

(c) Remove the six front and one rear attaching nuts, spacers and washers. Note the number, thickness and placement of the washers aft of the rear mounting bracket.

(d) Disconnect oil drain line and remove transmission from nose of engine.

(e) Cap all three oil line fittings on the transmission and the three oil lines on the engine.

4.4.1.3 Installation of Propeller -

4.4.1.3.1 Transmission Installation -

(a) Install transmission on nose of engine aligning front and rear mounting brackets over their respective stud bolts.

(b) Check for the original number, thickness and placement of the washers aft of the rear mounting bracket and install the attaching nut and washer.

(c) Install and tighten the six front attaching nuts with one spacer and two washers under each nut.

(d) Check the normality of the transmission external gears to the engine crankshaft. The outer face of the transmission gears must be normal to the center line of the crankshaft within .007 inch. Add or remove washers behind the rear mounting bracket to bring normality within the reading.

(e) Torque fore and aft attaching nuts to 300 inch-pounds.

(f) Remove the caps and attach the governor oil lines and the oil drain line to the transmission and tighten.

(g) Attach the transmission harness to the cannon plug on the rear baffle, tighten finger tight and safety. Clamp harness in place on the cowling.

4.4.1.3.2 Propeller Installation -

If the transmission external gears have been rotated the cam for the hydraulic stop valve plunger will be incorrectly located. The location will vary with each transmission; however, in most cases the plunger will be located approximately 3/16 inch from the point of the cam when the valve is closed. Hold the aft transmission external gear and rotate the forward external gear until the plunger rides in this approximate position.

(a) Manually turn the propeller pitch change gear until the blades contact their solid low pitch stops then back off ten teeth. If the propeller and transmission external gears have been wired together, omit this step.

(b) Clean and brush a light coat of engine oil on the propeller and transmission external gears and the engine crankshaft.

(c) Slide the propeller over the shaft carefully meshing the external gears and the engine crankshaft.

(d) Tighten the hub retaining nut with a torque of 400 to 440 foot-pounds.

(e) Inspect for a minimum of 1/16-inch clearance between the rivet heads on the transmission pitch change gear and the propeller worm drive gears. The propeller external gears should track as nearly as possible to the center of the transmission external gears, consistent with the clearance requirement. Add or remove spacers behind the propeller rear cone to establish the 1/16 minimum clearance and gear track.

(f) Inspect for .004 to .014 inch backlash between the propeller external gears and the transmission gears. Adjust backlash by relocating the forward transmission mounting bracket. The backlash tolerance given applies to installations with new propeller and transmission external gears. If gears are worn backlash tolerance will not apply. Observe gear tooth wear tolerance.

(g) Install clevis pin and safety.

NOTE

Unless the original transmission remains installed and its cam settings have not been altered, disconnect the wires leading to the electric feathering motor until the feathering and unfeathering cams are ready to be adjusted. Serious damage may result to the motor if these leads are connected prematurely. See instructions under propeller and transmission installation adjustments.

(h) Remove the safety wire around the propeller and transmission external gears.

(i) Run engine at 2000 rpm with propeller control in full increase rpm position for at least 10 seconds and shut down without moving propeller control.

(j) Check propeller blade angles with bubble protractor at 36 inch station (36 inches from propeller hub center or 13-1/4 inches from tip) as in figure 4-4. If the proper low-pitch reading (low pitch setting is 13-3/4°) is not obtained, it will be necessary to loosen retaining nut and back off propeller sufficiently to change mesh of pitch-change gears. Rotating pitch -change gear (2, figure 4-2) of propeller assembly six teeth changes blade angle approximately 1/2 degree. Clockwise rotation of gear (as viewed from front of airplane) increases blade angle, and counterclockwise rotation decreases it. Remesh gears, being careful not to change new relative position of transmission gears. Tighten retaining nut and recheck blade angle, repeating above procedure, if necessary, until desired reading is obtained. Install clevis pin and safety.

NOTE

Unless propeller shaft is perfectly level, blade angle will have to be determined by averaging the readings taken off both blades with the propeller horizontal.

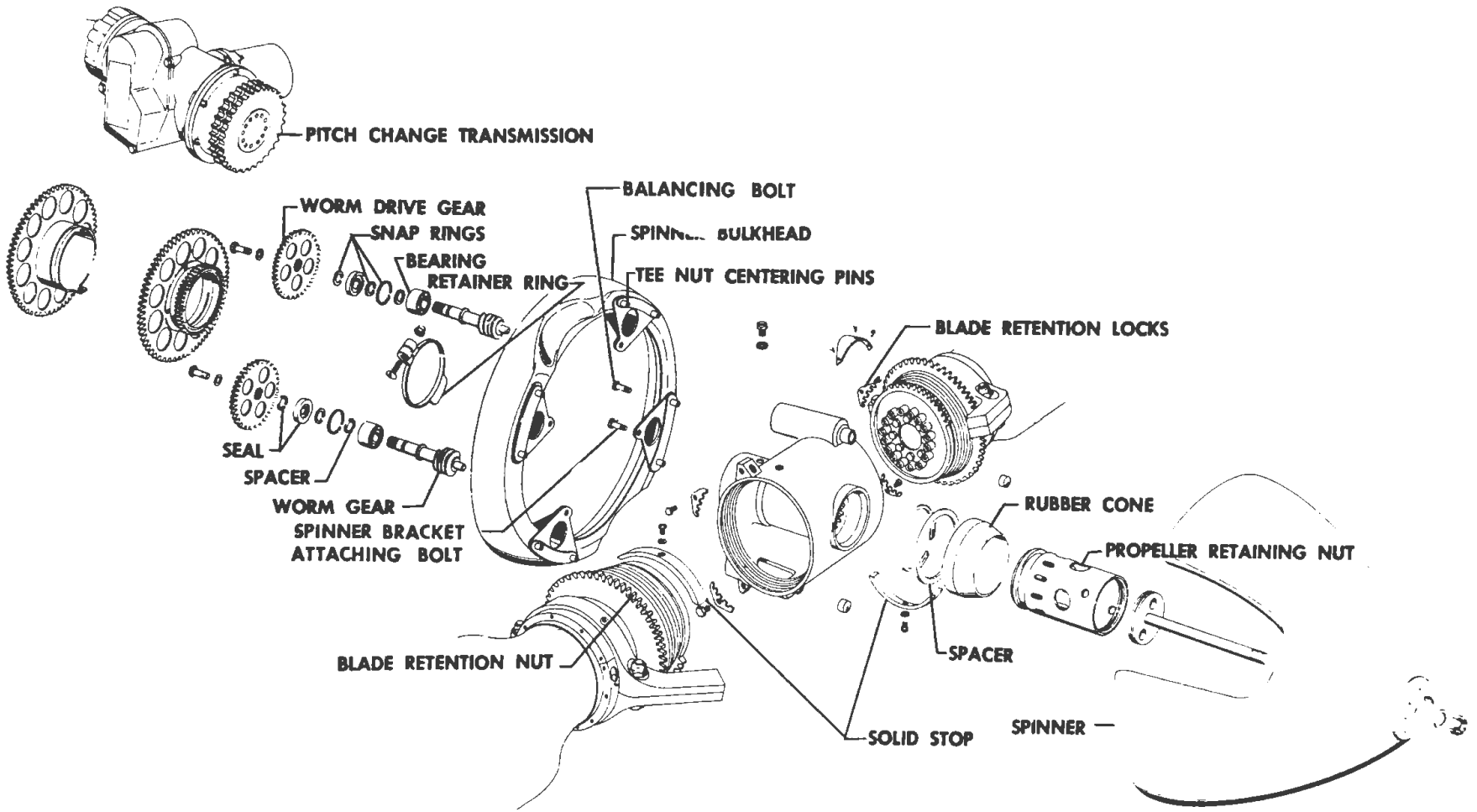



Figure 4-5. Model 214 Propeller Assembly

(k) If it has been necessary to disengage propeller gears from transmission gears in step (j), run up engine as in step (i) and recheck blade angles.
(l) Install spinner.
(m) With master switch off, connect electrical leads to motor.
(n) Check feathering and unfeathering limits and adjust cams, if necessary, as per paragraph 4.4.1.4 (c).

CAUTION

Cam adjustments must be made shortly after engine run-up, while the hydraulic motor still is full of oil. The normal drag of this oil will minimize coasting of the electric motor, after the switch is opened. Without this drag, however, the electric motor in some instances may coast past the high (cutoff) portion of the cams, closing the switch once more. Should this occur, the propeller blades will be run quickly against the internal positive stops, causing serious damage to the electric motor.

4.4.1.3.3 Spinner Installation -
(a) Before installing spinner, determine that all of the 268-378 rubber strips are secure in the spinner bulkhead and inspect bulkhead for evidence of fatigue cracks, especially around the bulkhead to hub attaching brackets.
(b) Clean the spinner locating pins of glue, paint, burrs, etc., and place the spinner over the locating pins making sure it contacts the rubber strips evenly around the circumference of the bulkhead. Rotate the spinner as necessary to obtain the best fit.
(c) Remove spinner shell and install the cone spacers and rubber cone on the hub retention nut.
(d) Install spinner shell. The spinner shell should contact the rubber cone while there is still approximately 1/8 inch clearance between the rubber strips in the bulkhead and the aft portion of the spinner. Correct spacing for this adjustment is accomplished by adding 268-380 spacers behind the rubber cone.
(e) Install washer and nut. Draw nut up until rear of spinner contacts the rubber strips on the bulkhead evenly, then tighten one to two turns and safety.

NOTE

If spinner attaching nut does not line up with key hole in the retainer bolt the retainer assembly may be adjusted in the hub retention nut.

4.4.1.4 Adjustment -
(a) Adjust feathering control switch (on firewall) to operate just after the propeller lever clicks the safety detent and enters the feathering position on the console.
(b) If the external transmission gears have been rotated individually, that is, one gear rotates while the other is stationary, the low pitch setting in the transmission will be changed. To reset the low pitch setting position the cam on the valve as shown in figure 4-3. Rotate propeller blades about 15 teeth from low pitch stop and run the engine with propeller control in high rpm position at about 2000 rpm. Stop engine and the low pitch setting is again established in the transmission. Set the blade angles at 13-3/4 degrees as outlined in step j above. This is a fraction of a degree higher than the setting of the mechanical low-pitch blade stops. However, it is important that this clearance between stops be maintained, for if the hydraulic motor is allowed to run the blades against the mechanical stops, excessive squealing and consequent wearing of the gears will result.

CAUTION

To assure adequate clearance between stops, pitch change gear (2, figure 4-2) should never be less than six teeth off the mechanical low-pitch stop.

(c) Adjust feathering and unfeathering limit switches as follows:
(1) Remove the limit switch cover.
(2) Loosen nut (1, figure 4-3) which locks both cams.

CAUTION

When loosening or tightening nut (1) the spacer (3), with the flat sides, between the cams must be held to prevent stripping the teeth off the bronze cam drive gear inside the transmission.

(3) To establish a coarse feathering limit, place propeller control in feathered position and turn on master switch, turning it off again shortly before blades reach the fully feathered position. Adjust feathering cam (2) to click limit switch off at this point and tighten nut.
(4) To establish a coarse unfeathering limit, move propeller control into unfeathering range and turn on master switch, turning it off again shortly before the blades reach the 45-degree position.

NOTE

If no unfeathering action is obtained, the unfeathering cam is probably holding the limit switch open. If such is the case, rotate the cam enough to bring its low portion into contact with the switch roller.

Loosen nut (1), (note CAUTION in step 2 above) and adjust unfeathering cam (4) to click limit switch off at this point, being careful not to disturb the feathering cam setting. Tighten nut.
(5) Measure feathered and unfeathered limits with protractor at 36 inch station to determine error of the coarse adjustments.
(6) Make fine trial and error adjustments, as required, by moving each cam in the direction necessary to establish the final unfeathering and feathering limits at 45 degrees and 84 degrees, respectively. The tolerance on these setting is plus or minus 1/2 degree. In making the fine adjustments, finish adjusting the unfeathering cam before resetting the feathering cam.

(7) With adjustments completed and nut (1) securely tightened, recheck both limits with protractor.
(8) Replace limit switch cover.

4.4.1.5 Setting the Propeller Blade Angle -
If a propeller surface table is not available for checking blade angles, install the propeller on the airplane. Turn the propeller to the horizontal position and with a level on the hub place the propeller in a level horizontal position. Also the airplane must be leveled longitudinally to give an accurate blade angle reading. Measure the angle of one blade and without moving the blade or the airplane measure the blade angle of the other blade. They should be within 1/4 degree of each other. If the blades are not within the 1/4 degree tolerance or if they are not set at 13-3/4 degrees change the blade angle settings as follows:
(a) Break the safety wire on the two gear sleeve attaching screws, located 180 degrees apart on the lower portion of the hub, and remove the screws.
(b) Loosen the clamp screw in the gear retainer ring and remove the external gears enough to disengage the worm drive gears (5, figure 4-2) from the hub.
(c) Set the low pitch on each blade to 13-3/4 degrees by rotating the worm drive gears. Align the external gear assembly to engage the worm drive gears and press the remainder of the way on.
(d) Insert the two attaching screws, tighten, and safety. Tighten the retainer ring clamp screw.

4.4.1.6 Static RPM Adjustment -
Prior to checking the static rpm on the 272 propeller (metal blades) exercise the propellers through their full range two or three times to make sure that the transmission has an adequate supply of warm oil.

If the low pitch cam (6, figure 4-3) stops the propeller at the correct low pitch angle of 13-1/4 degrees and a static rpm reading of 3200 to 3250 rpm is obtained with full engine power, it should not be changed. If a static rpm reading of 3200 to 3250 rpm cannot be obtained, check the engine timing, carburetion and ignition before changing the low pitch setting; the static rpm is the result of both the pitch setting and the engine power output. See paragraph 4.4.1.3.2, step j for correction of static rpm by adjusting the propeller low pitch stop.

When checking the static rpm turn the airplane 90 degrees to the wind to keep the static rpm out of the maximum governor range. If the airplane is headed into a moderately strong wind, the rpm may reach 3400, due to the reduced propeller load. The governor will control the propeller and the static rpm reading will not be true.

4.4.1.7 Balancing the Propeller -
Place the propeller on a balance fixture and check for proper balancing. If the propeller requires balancing, the grease in the hub must be removed as the propeller must be balanced before packing with grease. The propeller is balanced by adding or subtracting washers from bolts in the tee-nut centering pins in the spinner bulkhead. These nuts are accessible through holes in the rear of the spinner bulkhead and should be safetied after the addition or removal of washers. After the propeller has been balanced the inside of the hub must be packed with 1-1/4 pounds of grease, Specification MIL-L-7711. Due to centrifugal force on the grease, equal amounts must be placed on either side of the hub. Remove the blades and place 5/8 pound of grease on each blade segment gear. Install the blades carefully so that no grease is lost outside of the hub and establish the blade torque. To determine the correct blade torque screw the blade retention nut into the hub holding the blade near the tip. Make the last few turns cautiously until all axial end play disappears from the blade. Back off blade retention nut 1-1/2 notches or until a small amount of play may be felt between the blade sleeve and the blade retention nut. Secure the blade retention nut with the locks that attach to the hub.

NOTE

Overtightening of the blade retention nut will result in damage to both the blade thrust bearing and the blade segment gear in addition to making the propeller very stiff when changing pitch.

4.4.1.8 Propeller Blade Maintenance -
The leading edge of the propeller blades and the adjacent area within 1-1/2 inch of the leading edge must be kept free from nicks, gouges, scratches, etc. A smooth fine polish is highly desirable.

4.4.2 Propeller Transmission Oil Line Heaters -
The propeller transmission oil line heaters consist of two heater elements, one installed on the increase and one on the decrease transmission oil lines, propeller transmission heater switch installed on the left subpanel and an amber light located to the right of the stall warning indicator light on the instrument panel which will come on when the switch is on.

NOTE

The amber light does not indicate that the heater elements are functioning properly, but merely that current is being supplied to the elements.

Before practicing single engine procedures in extremely cold weather turn on the propeller transmission oil line heaters if the propellers do not respond normally to changes in power settings during the warm-up period or during the engine run-up. Allow about five minutes for warm-up. They should not be used, however, unless the engines are running.

While in flight, in addition to exercising the propellers at intervals to circulate warm oil through the lines and the governor, turn on the propeller transmission heater switch, whenever erratic tachometer indications or sluggish response to change in the power settings indicate congealed oil in the lines of the governor.

Check the lines at regular intervals for burned out heater elements. This may be accomplished by turning the propeller transmission heater switch to ON,

with the engines running. Allow a few minutes for the heater element to warm up, then stop the engines and feel the lines. If the lines are warm, the heater elements are functioning properly. If the heater element is burned out, it will be easier and probably less expensive to replace it with a new tube assembly, part number 50-960003-604, increase propeller rpm, or 50-960003-606, decrease propeller rpm. The heater element is installed and the lines are insulated on these tube assemblies.

4.4.3 Propeller Overhaul -

Propeller overhaul is recommended at engine overhaul periods. Each period between propeller overhauls should not exceed 1000 hours. Repairs, such as replacing an external gear may become necessary before the end of this period; however, repairs of this nature can be accomplished without complete overhaul by following the applicable steps in this manual.

Each propeller overhaul will be accomplished in accordance with the following operations and the instructions given for each operation:

(a) Disassemble hub and blades.
(b) Clean all parts.
(c) Magnetically inspect all steel parts.
(d) Inspect the nonferrous parts by one of the following methods.
1. Anodic treatment - aluminum only.
2. Caustic soda etch - aluminum only.
3. Near ultraviolet light - any nonferrous part.
(e) Inspect all parts for wear in accordance with wear limitation charts.
(f) Replace all parts that do not conform to inspection requirements.
(g) Replace all seals, snap rings and the needle bearings.
(h) Reassemble and balance propeller assembly.

4.4.3.1 Propeller Disassembly -

(a) Mark the relationship of the spinner bulkhead to the propeller hub.
(b) Mark the location of the propeller blades in the hub. The low number blades should be on the side of the wide spline in the hub.
(c) Rotate the pitch change gear until the propeller blades hit the solid low pitch stops. Check and record the low pitch.
(d) Turn the propeller over and remove the spinner bulkhead by removing the four attaching bolts and washers.
(e) Turn the propeller right side up and remove the blade retention nut locks.
(f) Remove the propeller blades. If necessary the blades may be removed without first removing the spinner bulkhead.

4.4.3.2 Hub Disassembly -

(a) Unsafety and remove the two screws attaching the drive gear and sleeve assembly.
(b) Loosen the screw in the pitch change gear retainer ring.
(c) Remove the drive gear and pitch change gear assembly. If the assembly fits tightly to the hub,tap on each side with a mallet.
(d) Remove the screw in the retainer ring and remove the retainer ring and the pitch change gear.
(e) Remove the bolt and washer retaining each worm drive gear and remove worm drive gears.
(f) Remove the worm gear seals, snap rings and spacers at the wide opening of the worm gear housing. The seals will be damaged during removal.
(g) Remove the worm gear and bearings.
(h) Remove bearings from worm gears.
(i) Press out the upper worm gear needle bearing.
(j) Remove the two bolts on each side of the hub and remove the blade stops.

4.4.3.3 Blade Disassembly -

Under no circumstances should the blade be disassembled any further than given in the instructions except at the factory.

(a) Check for the etch mark on the blade sleeve in line with the position where the counterweight halves come together and the blade serial number on the counterweights. If markings have been obliterated remark accordingly.
(b) Loosen the set screws, remove the attaching bolts and remove the counterweights.
(c) Mark the location of the blade balance ring, remove the Allen head screws and remove the balance ring.
(d) Remove the 31 bearing balls from between the blade bearing races.
(e) Raise the blade retention nut and shake out the bearing race that locates within it. If race does not fall out, mask off shank of blade, raise the retention nut up and off the steel sleeve and drive the race out with a drift punch.
(f) Remove the blade seal.

4.4.3.4 Cleaning -

After propeller disassembly remove the excess grease and thoroughly clean the parts in an approved noncorrosive cleaning solution. Do not use abrasives or cleaning devices that may score, scratch or remove the parent material. Dry the parts with an air blast and lay them out for inspection. If the parts are to lie idle for some time they must be protected with a light coat of an anticorrosive compound. The anticorrosive compound must be removed and the parts recleaned prior to assembly.

4.4.3.5 Inspection -

All parts must be clean and dry for the initial visual inspection. Carefully examine all parts for galling, cracks, burrs and other obvious irregularities. Check all plated and painted parts for exposed parent material.

4.4.3.5.1 Magnetic Inspection -

Magnetically inspect all steel parts except bearings. This inspection should be carefully made by competent qualified magnetic inspection machine operators.

Indications of cracks by the magnetic inspection process will be found at the joints of the lugs and worm gear housings on the sides of the hub body and at the joint of the spider at the front of the hub body These joints are copper brazed and must not be con-

| REF. NO. | NAME | REPLACE AT | REMARKS |
|---|---|---|---|
| 1 | PITCH CHANGE GEAR BEARING | .010 IN. | TOTAL SIDE PLAY BETWEEN BEARING & SLEEVE |
| 2 | PITCH CHANGE GEAR BEARING | .016 IN. | TOTAL END PLAY OF PITCH CHANGE GEAR BETWEEN RETAINER RING & SLEEVE |
| 3 | SMALL PITCH CHANGE GEAR | 4.009 IN. | PIN READING OVER TWO .108 IN. DIA. PINS |
| 4 | LARGE PITCH CHANGE GEAR | .0892 IN. | CIRCULAR TOOTH THICKNESS - ADDENDUM IS .0625 |
| 5 | PROPELLER DRIVE GEAR | .1475 IN. | CIRCULAR TOOTH THICKNESS - ADDENDUM IS .1000 |
| 6 | WORM GEAR | .025 IN. | TOTAL END PLAY |
| 7 | BLADE GEAR & WORM GEAR | .035 IN. | MAXIMUM BACKLASH BETWEEN BLADE GEAR & WORM GEAR |
| 8 | WORM DRIVE GEAR | | WEAR ON GEAR TEETH WILL NOT BE DISTRIBUTED UNIFORMLY AROUND THE GEAR. EXCESSIVE WEAR CAN ONLY BE JUDGED BY VISUAL INSPECTION. SEE TEXT FOR USE OF GEARS. |

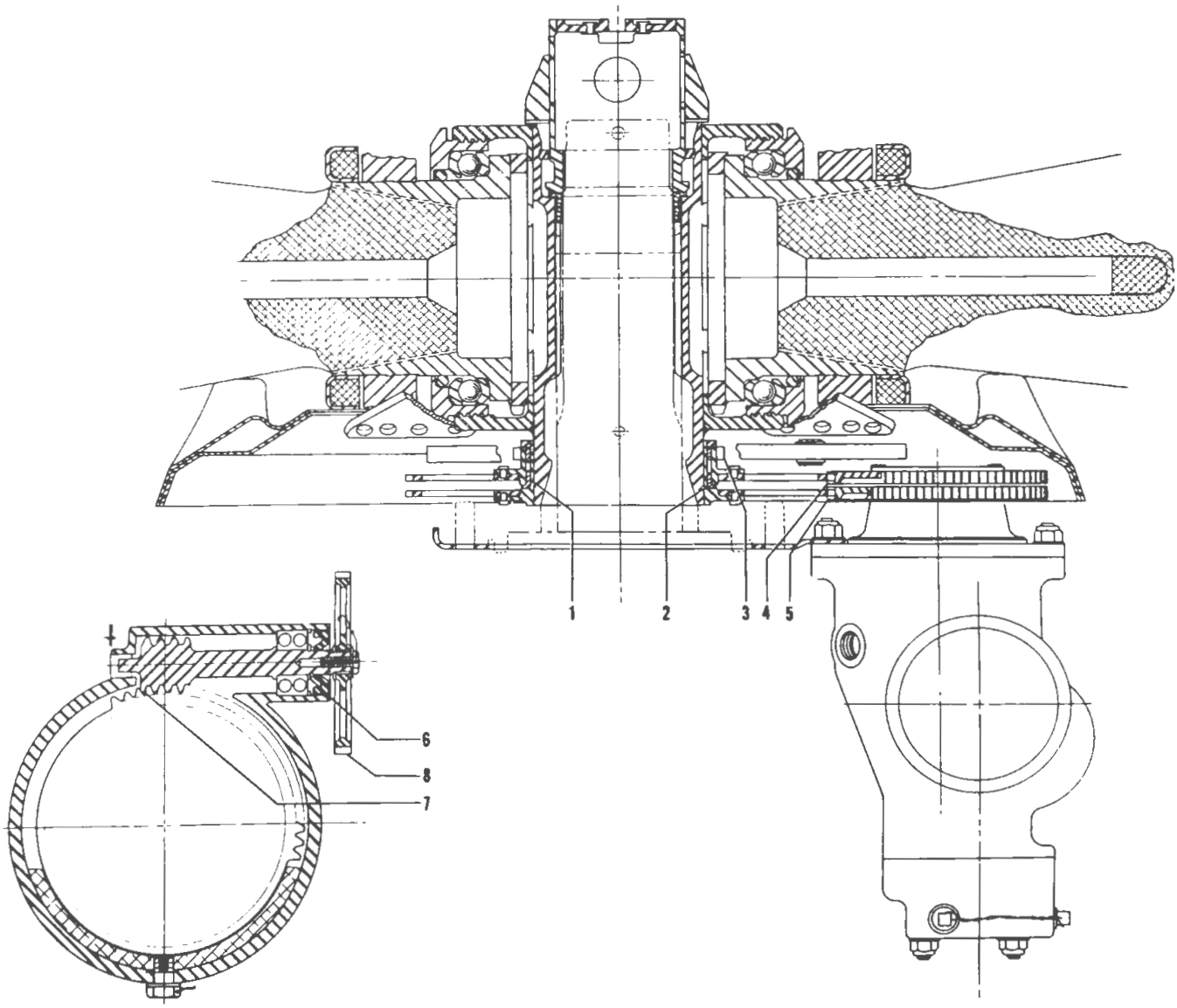



**Figure 4-8. Propeller Clearance Chart**

Figure 4-7. Bearing Race Removal

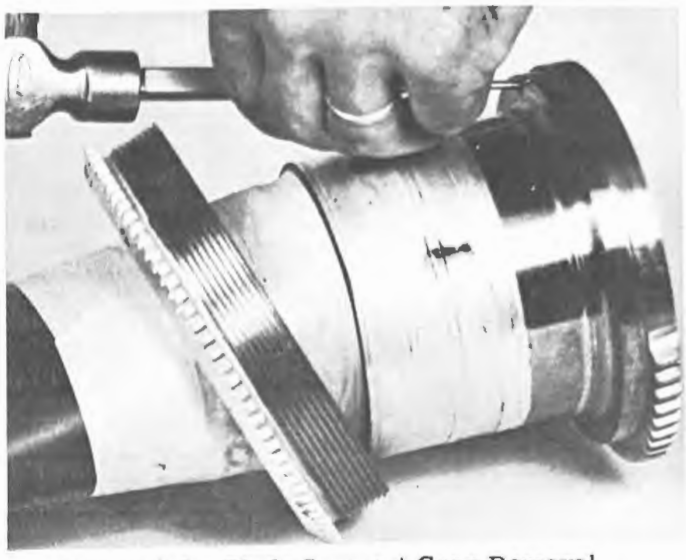


Figure 4-8. Blade Segment Gear Removal

sidered as cracks. If the indication is questionable, demagnetize, clean and reinspect by the following method. Etch the area with a solution of five percent nitric acid in ethyl alcohol. Thoroughly rinse the area with water and inspect under an eight or more power magnifying glass or microscope. If the crack is completely filled with copper it will appear as a bright line in the area which was turned dark by the etching solution. Cracks filled with copper that have not progressed will be considered acceptable.

All parts with cracks must be rejected and replaced with new parts of the same part number or acceptable interchangeable parts.

After the magnetic inspection demagnetize all of the parts and thoroughly clean to remove all magnetic inspection particles.

4.4.3.5.2 Hub Assembly Inspection - Thoroughly clean and inspect the lower worm gear bearings. The bearings must roll freely and quietly and must be free of any obvious or questionable defects. The chamfer on the inner race must be slight for a good bearing surface on the snap ring that holds it in place on the worm gear shaft.

The upper worm gear needle bearings need not be inspected as they must be replaced each time they are removed.

Carefully examine all parts and fits to the dimensions and clearances given in the clearance chart, figure 4-6 . The allowable service limits are given in the "Replace At" column. The dimension and clearance columns are the manufacturing tolerances. The letter "T" indicates a tight or press fit and the letter "L" indicates a loose fit. All dimensions and clearances that measure to or exceed the service limitations must be replaced.

4.4.3.5.3 Anodic Treatment for Aluminum Blades - Where facilities are available the blades will be inspected for cracks by anodizing the blade surface and careful inspection for evidence of cracks. The anodic film shall cover the entire exterior surface of the blade, except that the six-inch area from the shank may be inspected by fluorescent inspection. Completely mask off the blade retainer and steel sleeve. Following the anodic treatment, the blade should be thoroughly rinsed in water which is the same temperature, or lower than the anodizing bath. The rinsing time should not exceed five minutes. After rinsing, the blade should be air-dried at room temperature. Allow at least fifteen minutes drying time. An air blast may be used to insure proper drying if desired.

After the blade is thoroughly dry, conduct a careful visual inspection for evidence of cracks. Cracks will usually show up as a brown line against the clear anodized surface. Remove all cracks using the same procedure as given for removal of dents and abrasions, within the limits of the repair limit chart.

All blades having cracks that cannot be completely removed within the limits established by the repair limit chart and procedure will be scrapped.

After the cracks have been removed, the blade may be reanodized to cover the surface of the repaired area. If it is desired to seal the anodized surface for additional protection against corrosion, immerse the blade in clear water at a temperature of 160 to 180 degrees Fahrenheit for 10 to 15 minutes.

4.4.3.5.4 Caustic Soda Etch For Aluminum Blades - Caustic etching may be used to inspect blades for cracks. The blade should be etched from the tip to the six-inch station and then neutralized in a nitric acid bath. The blade retaining nut, ferrule, bearing race, etc., should not be allowed to come in contact with the etching solution. The etching bath may be prepared by using a solution of one pound of commercial technical grade caustic soda for each gallon of water. The neutralizing bath is composed of one part concentrated technical grade nitric acid to five parts water. The etching solution should be maintained at a temperature of 150 to 170 degrees Fahrenheit. Dip the blade in the solution and allow it to remain 30 seconds. Immediately rinse the blade in

clear warm water, then dip the blade in the neutralizing bath. After the black deposit is removed, rinse the blade in clear warm water.

Carefully inspect the blade for cracks. The cracks will appear as dark lines; if viewed through a magnifying glass, small bubbles may be observed emerging from the crack.

All blades that cannot be repaired within the limits of the repair limit chart must be scrapped.

4.4.3.5.5 Crack Detection by Near Ultraviolet Light - Nonferrous parts may be inspected for cracks by use of near ultraviolet light inspection in conjunction with a solution of 50 percent aircraft engine oil and 50 percent kerosene. The solution should be tested to make certain that it has fluorescent quality.

Clean the parts carefully with carbon tetrachloride and dry the blade thoroughly, using an air blast if necessary. The fluorescent oil solution should be placed in a suitable dipping tank and maintained at a temperature of 90 to 130 degrees Fahrenheit.

Completely immerse the parts in the solution and allow to remain for a minimum of thirty minutes. After this period remove the parts from the bath and allow the excess fluid to drain. Spray the parts with carbon tetrachloride to completely remove the remaining solution. Allow the parts to stand for fifteen minutes so that the solution will bleed out of any cracks present.

Carefully inspect for cracks under a near ultraviolet light source. The inspection must be conducted in a darkened booth or room. Solution bleeding from a surface crack will show up under the light as a bright fluorescent line.

Reject all cracked parts except aluminum propeller blades that may be repaired in accordance with the limits in the repair limits chart.

4.4.3.5.6 Inspection After Overspeed (Engine RPM) - Inspection and disposition of propellers which have been momentarily overspeeded, infrequently and up to a maximum of five seconds in each instance, is to be as follows:

(a) Up to 3750 rpm - Visually inspect.

(b) 3750 to 4000 rpm - Disassemble and magnetically inspect all steel parts; inspect the aluminum portion of blades for cracks by one of the approved methods, visually examine blade hardware and blade retention sleeve, but do not disassemble blade hardware.

(c) Over 4000 rpm - Scrap blades and hub.

4.4.3.5.7 Inspection of Propeller Blade Retention - Inspect the propeller blade retention at each periodic inspection by placing the thumb and index finger at opposite sides of a point between the aluminum blade and the steel retainer and working the blade back and forth with the other hand applied to the tip. If any movement is felt, immediately follow up with the dial indicator check as explained for the overhaul inspection below.

At each overhaul period the propeller blade retention will be checked with a sensitive dial indicator graduated in .0001 inch increments. Remove the blade balance ring according to the instructions given in Blade Disassembly and mount the dial indicator from the blade counterweight. Do not mount from any part of the hub assembly. Apply the dial indicator at the bottom of the radius adjacent to the steel retainer and move the blade back from the tip end. Make this same check by applying the dial indicator 90 degrees to the first application. Any movement of the blade that indicates over .0005 inch is cause for rejection.

4.4.3.6 Repairs and Replacements - Each part which inspection has found damaged or worn must be either replaced by a satisfactory part or repaired according to the instructions given. If repair is impossible, the part should be scrapped. Snap rings, oil seals and the worm gear needle bearing will be replaced if removed at any time for any reason. The propeller as a unit shall be considered satisfactory only if all of the parts are within the specified limitations.

4.4.3.6.1 Steel Parts - Using a fine stone, fine emery cloth, and crocus cloth, carefully eliminate all evidence of galling, nicks, burrs, and similar damage. Use extreme care to remove the damage completely, and yet do not remove more material than necessary. Leave no sharp edges or nicks.

4.4.3.6.2 Bronze Parts - With fine emery cloth and crocus cloth remove all burrs. It is generally unnecessary to eliminate a nick completely, as bronze parts are not highly stressed.

4.4.3.6.3 Plated and Painted Parts - Plated parts with exposed base metal will be stripped and replated. Painted parts may be touched up, using approved methods.

4.4.3.6.4 External Gears - The external gears must be examined carefully. The gear wear will be determined by measuring the circular tooth thickness. The case hardening on the gear teeth is .010 inch in depth, therefore during the propeller overhaul period the permissible circular tooth thickness given in the wear tolerance chart will be less than that allowed during service. This objective is to prevent a worn gear from getting back in service that will not last to the next overhaul period. Minimum circular tooth thickness at the overhaul period is .004 inch below the original circular tooth thickness and the minimum circular tooth thickness during service use is .010 inch below the original circular tooth thickness.

Service wear on the transmission and propeller gear teeth may increase the backlash to a maximum gear backlash of .034.

During the overhaul period the minimum

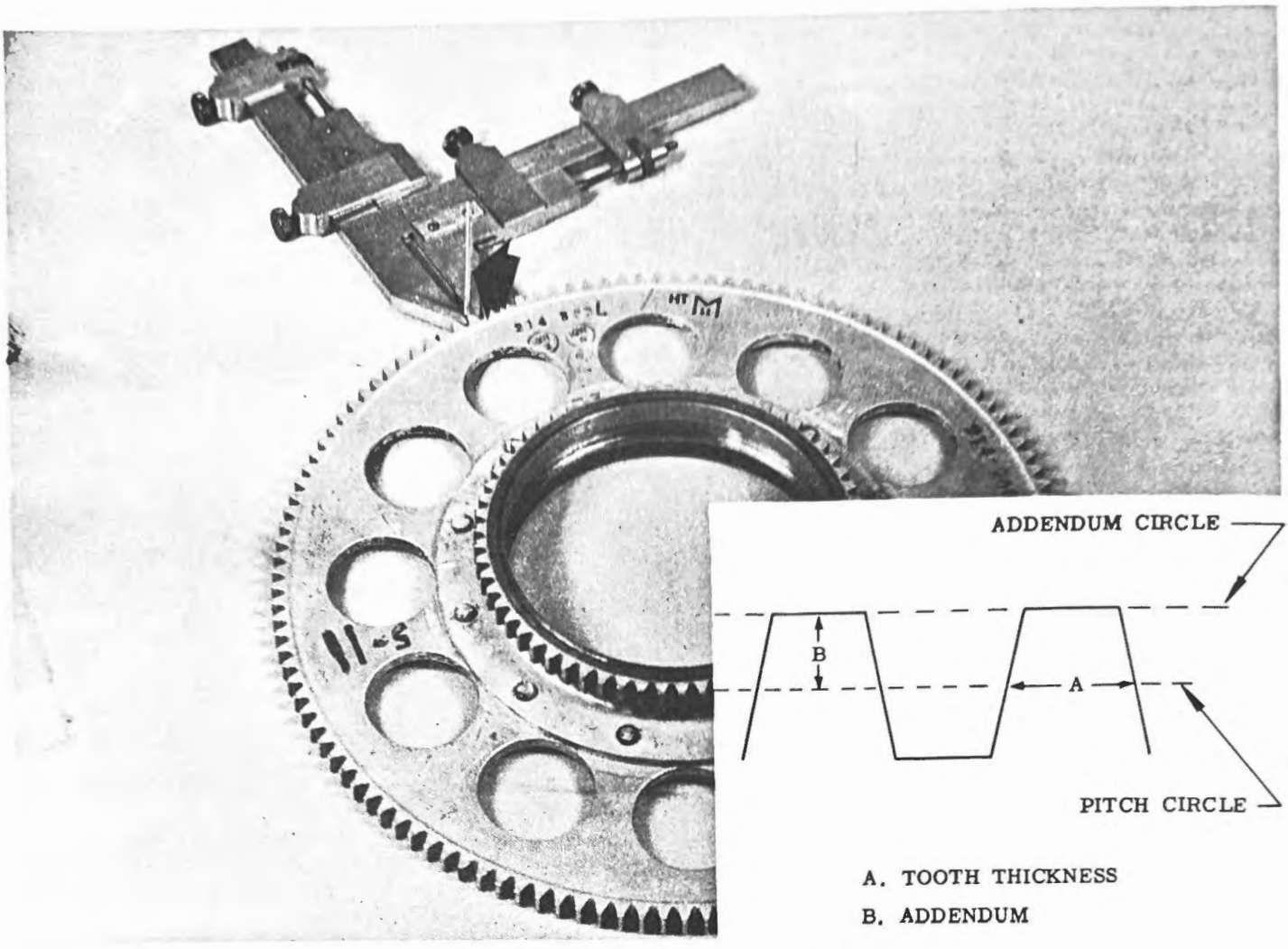



Figure 4-9. Measuring Gear Tooth Wear

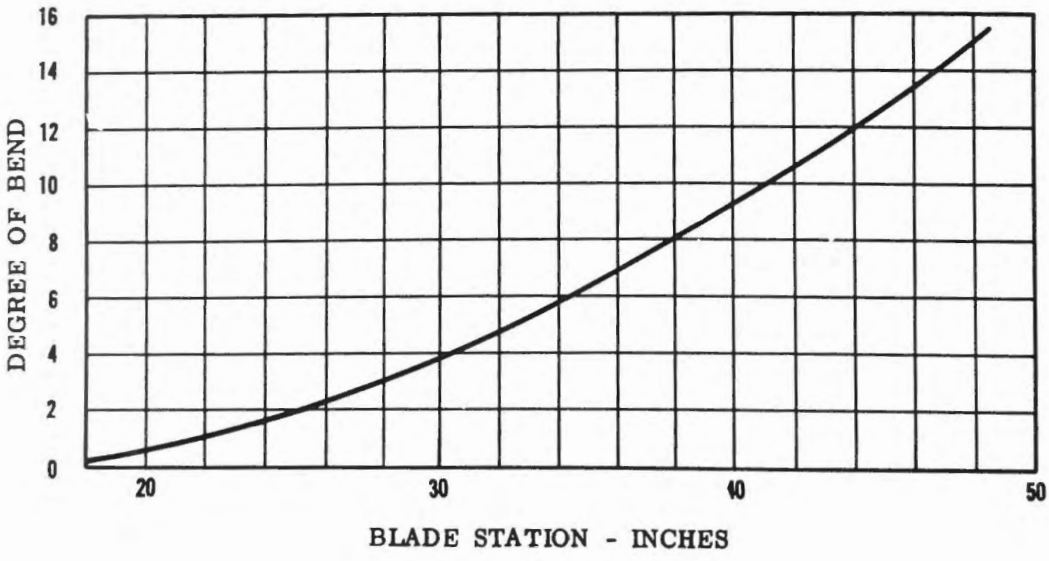



Figure 4-10. Maximum Bend Chart

circular tooth thickness of the large external gears during service should be checked with a gear tooth caliper as shown in figure 4-9. See figure 4-6 for minimum gear tooth thickness.

The addendum is the dimension between the addendum circle and the pitch circle. The addendum circle and pitch circle are shown in figure 4-9. The circular tooth thickness is measured at the gear pitch circle. Most gear tooth callpers cannot be set on an addendum below .1000 inch. Therefore, a given addendum smaller than .1000 inch will require a pin of known diameter to be located on the crown of the gear tooth. The addendum plus the diameter of the pin will be the addendum setting on the gear tooth caliper. With the addendum preset on the addendum caliper, the gear tooth caliper will measure the circular tooth thickness at the pitch circle when the addendum caliper rests on the pin located on the crown of the tooth. The minimum circular tooth thickness and addendum for each external gear is shown in figure 4-6. The addendum pin will be used on all gears except the 272-333 gear.

When replacing the drive gear or the pitch change gear the transmission gear to which it meshes should also be replaced. A new gear will not properly mesh with a worn gear and if used together their service life will be considerably reduced. Both propeller gears are riveted to their hubs using equipment which assures precise alignment; therefore, worn or damaged gears should be returned to the factory for repairs.

4.4.3.6.5 Replacing Blade Segment Gear -

(a) Mark location of the bronze segment gear on butt end of blade. The mark should be in line with the blade center line and the center of the end radius on the last segment gear tooth toward the leading edge of the propeller blade. The angle between the mark and the propeller and the 36-inch station will be 13 degrees 45 minutes as shown in figure 4-15.

(b) Remove bronze segment gear by using a four-way puller or by driving out the steel pins with a drift punch. The pins should be driven toward the bronze gear. See figure 4-8.

(c) Remove pins from gear.

(d) Align new bronze segment gear in its correct position and clamp in place. Refer to step a and figure 4-15.

(e) Drill and ream the four attaching pin holes using the holes in the ferrule as guides. All metal blades with the letter A before the blade serial number on the decal will have the holes in the sleeve reamed to .1875 inch. Those blades without the A are drilled and reamed to .1870 inch. Remove all burrs after reaming. If the .1870 inch holes are reamed to .1875 inch make certain an A is added before the blade serial number.

(f) Drive in four new attaching pins of the correct size. The pins should be driven through the bronze segment gear and into the blade sleeve flange. The pins must not protrude from the gear or the sleeve flange.

(g) Swell the pins in the bronze segment gear with a center punch.

4.4.3.6.6 Propeller Blade Repairs -

Metal propeller blade repairs will be confined to the limitations given in this repair section. Any deviations over the maximum repair limits may impair the best safety precautions and are not recommended. If it is necessary to reduce the dimension beyond the established limits the blade will be retired from service.

4.4.3.6.7 Minor Blade Repairs -

Dents and abrasions may be removed by use of suitable sandpaper or fine cut files. In no case should dents, nicks or abrasions be repaired by methods which attempt to relocate metal by cold working to cover or conceal the defect.

The defect should be corrected by removing material with files and sandpaper in such a manner that the finished repair will be well rounded off and all sharp corners removed.

4.4.3.6.7.1 Defects in Leading and Trailing Edges -

The minimum permissible chord at any station is given in the minimum chord chart, Figure 4-14. For local repairs on the leading and trailing edges the inside radius "r", and the outside radius "R", should not be less than 1-1/2 times the maximum depth "d" of the repair.

When it is necessary to repair a wide scar, dent or abrasion on the leading edge, the original contour of the blade leading edge must be maintained as nearly as possible. This will necessitate removing material back of the radius so that the blade contour will gradually fair into the radius.

4.4.3.6.7.2 Defects in Face of Blade at Maximum Thickness -

A maximum depth of 1/16 inch is permissible within 3/4 inch of the original leading edge or within 1-1/2 inch of the trailing edge. A maximum depth of 1/32 inch is permissible in the area between the above zones. The deepest part of a repair should not extend more than 1/2 inch along the long axis of the blade. For any local repair the inside "r" and the outside "R" radii measured in any direction should not be less than two times the maximum depth "D" as illustrated in figure 4-14.

If it is necessary to make repairs on both front and back of the blade at the same point, their combined depth should not exceed the maximum for one repair. Care should be used not to remove too much material in the region of the trailing edge near the tip. At least 1/2 of the original thickness should remain.

The blade thickness as shown on blade drawing may not be reduced beyond the manufacturing tolerance of .025 inch except for the allowables given for defects in the face of the blade at maximum thickness.

4.4.3.6.7.3 Number of Repairs -

There are no established limits to the number of times a blade may be repaired, provided

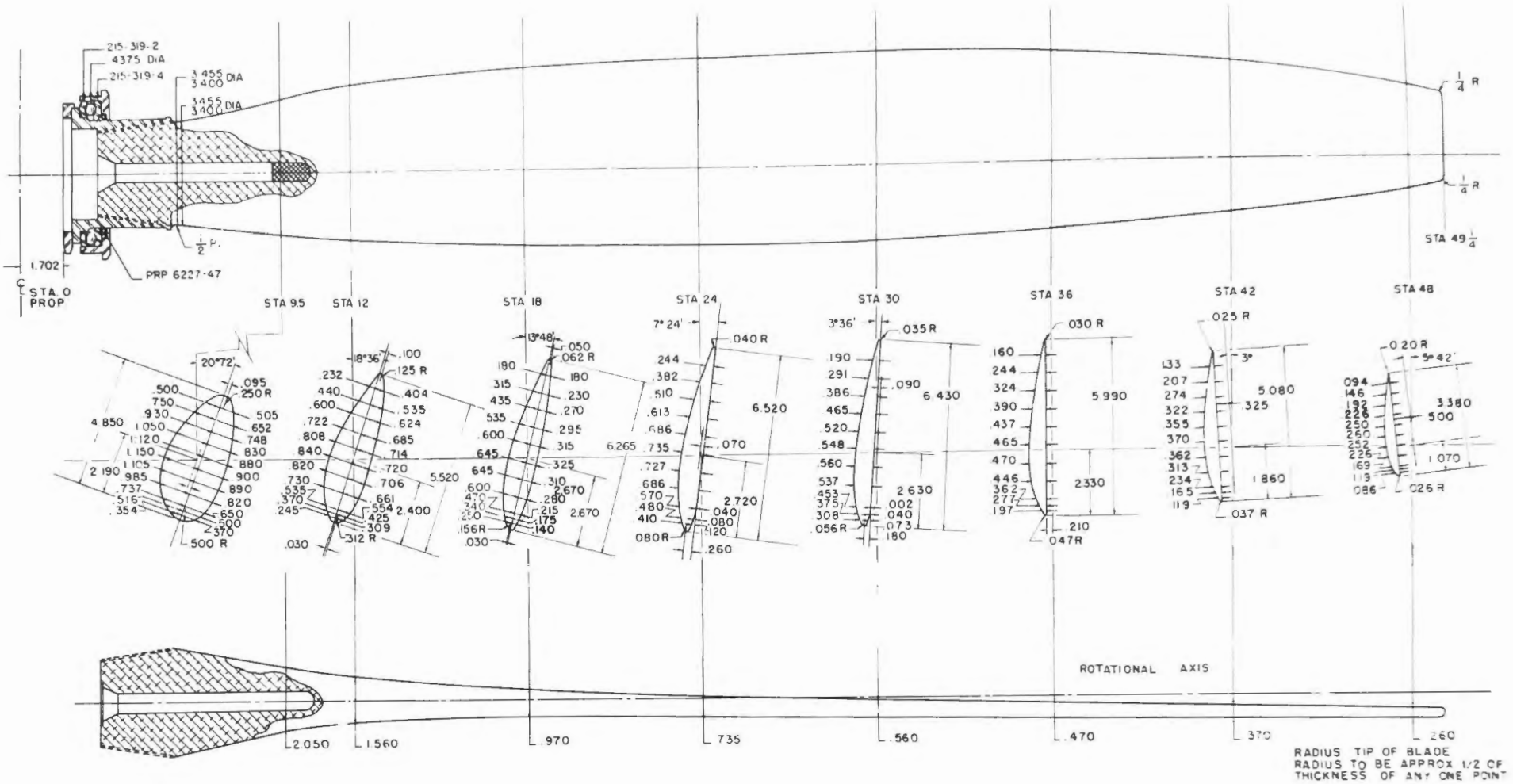



**Figure 4-11. Blade Stations and Dimensions**

all repairs are made within the allowable repair limits and that a group of repairs do not form a relatively straight or continuous line that would materially weaken the blade.

4.4.3.6.7.4 Blade Tip Repairs -
The original propeller blade diameter is 98-1/2 inches. The minimum permissible diameter is 97-1/2 inches.

When damage occurs in such a manner that it is necessary to remove a portion of the tip, it is permissible to shorten the length of each blade a maximum of 1/2 inch from the original design length. The tip cutoff may be shaped to the original design with a 1/4 inch radius at the corners; or at any permissible diameter, any radius between 1/4 and 3/4 inch may be used at the leading and trailing edges of the tip.

4.4.3.6.7.5 Repair of Bent or Twisted Blades -
The material of the 272 series propeller blades is 25ST aluminum. All repairs to the blades must be made with the blade in the "hard" condition. It is not permissible to anneal a blade. Before attempting to straighten a blade the damaged portion should be inspected to determine if the blade may be repaired within the given limitations. If the repair will exceed the maximum limitations the blade will be scrapped.

If the damage is such that it may be repaired within prescribed limits, check the maximum degree of bend using an adjustable protractor. The angle should be checked by setting the protractor so that the point of tangency is one inch each side of the center line of the bend. Check the entire bend area and refer to the bend limit chart, figure 4-10. If the degree of bend does not exceed the limits of the chart in any area, the blade may be straightened.

If the degree of bend at any point exceeds 50 percent of the allowable limit, the blade may be straightened only once and must be indicated by the symbol Z after the blade serial number. If the degree of bend is less than 50 percent the symbol S1 will be added after the blade serial number. Each time the blade is straightened, the figure number following the letter S will be changed to represent the number of times the blade has been straightened. After the blade is straightened it must be checked for cracks by use of the caustic etch procedure. If any cracks are found, the blade must be scrapped. Blades having bends in the area between the shank and Station 18 will be scrapped.

4.4.3.6.7.6 Straightening -
Bends are straightened with a rolling effect starting at the first bend from the shank and working out to the tip; however, the tip should be straightened first. All bends must be straightened in a press; in no case shall a blade be straightened by

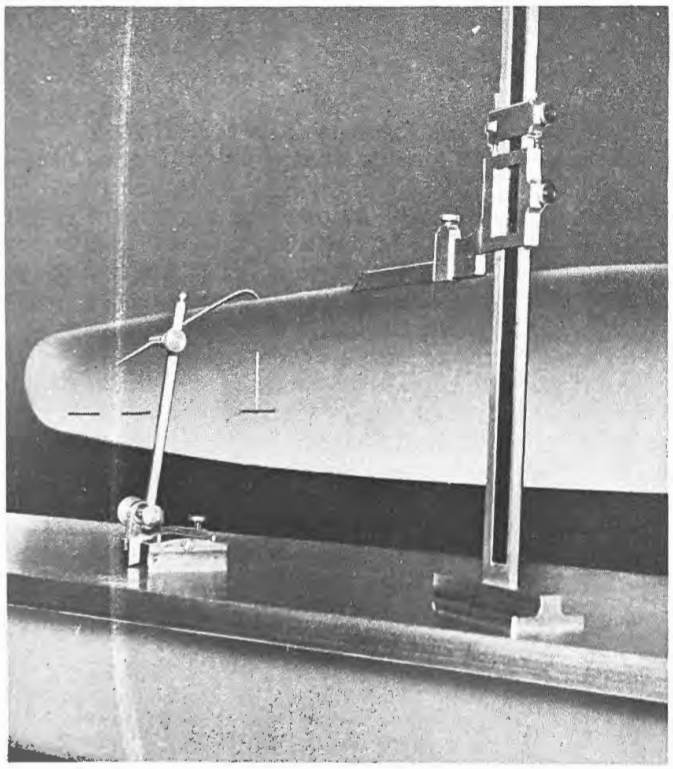


Figure 4-12. Edge Alignment Check

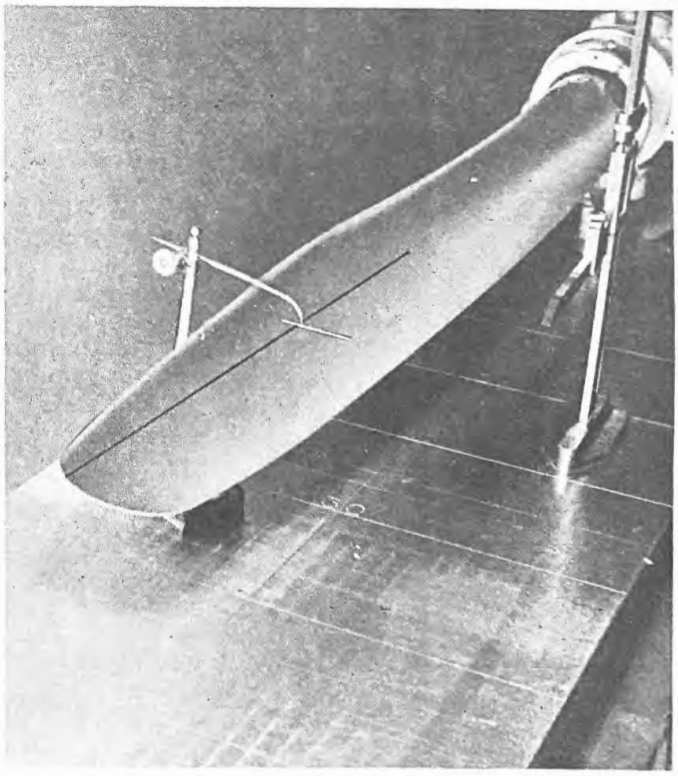
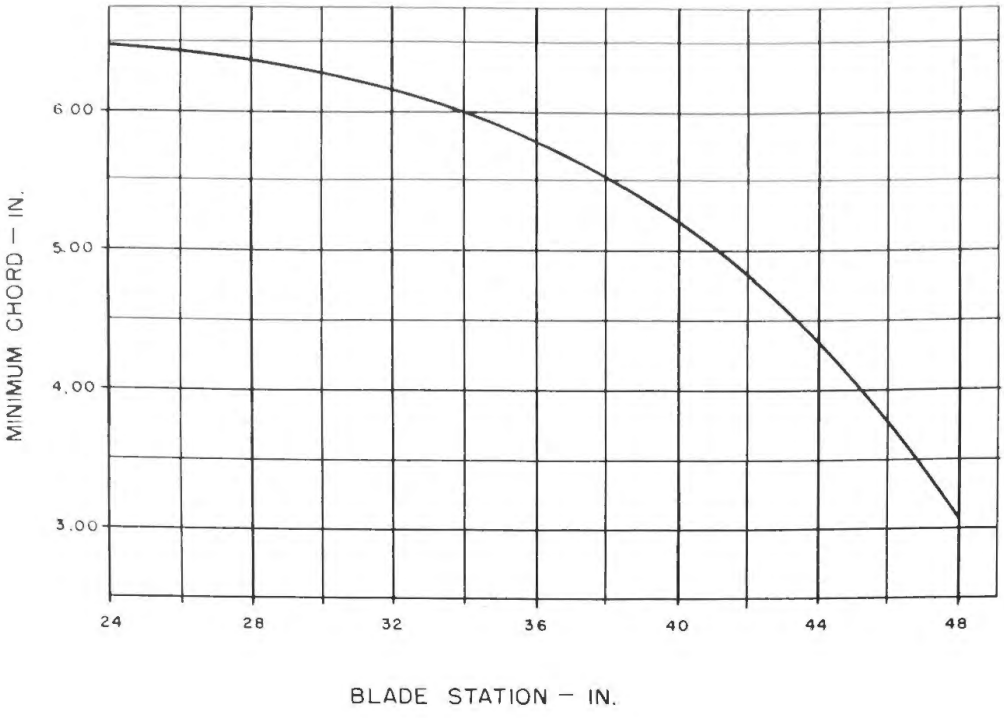


Figure 4-13. Face Alignment Check



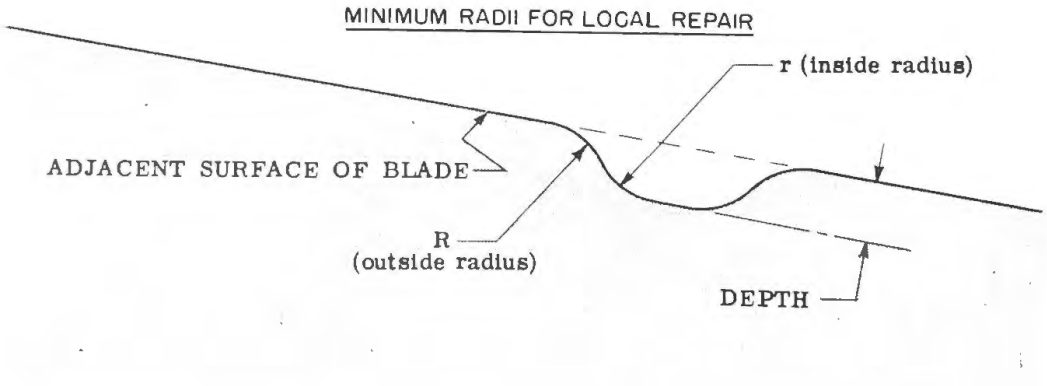




**Figure 4-14. Blade Repair Limits**

hammering.

The shank of the blade may be supported on the press bed with a wooden dolly and padded. Wooden blocks should be used on both sides of the blade to prevent scarring the surface. Apply pressure on one side of the bend; never apply pressure in the center of a large bend. During the process of straightening the blade, check the alignment with a straight edge. Kinks in a blade may be removed by clamping the blade in a vise and applying pressure with a large wrench.

The alignment of the blades should be checked on a surface table after completing the straightening procedure. Check the blade angle at the following stations:

| Station | Blade Angle |
|---|---|
| 9.5 | 20° 12' |
| 12 | 18° 36' |
| 18 | 13° 48' |
| 24 | 7° 24' |
| 30 | 3° 36' |
| 36 | 0° 00' |
| 42 | 3° 00' |
| 48 | 5° 42' |

Blade angles must conform to this chart within the tolerances given in the manufacturing tolerance chart.

The blade angles are checked with reference to the 36 inch station at 0 degrees. Blade angles from the 18 inch station to the tip may be twisted to the correct angle by use of a blade twisting machine. If a blade is twisted more than 0 degrees 30' from design angle at any station from 18 inches to the shank, the blade will be retired from service.

Blades that have been bent and repaired must be inspected for cracks at each 100 hour period.

Edge alignment may be checked by locating the rotational axis of the blade. This may be accomplished by referring to the blade drawing, figure 4-11 . When laying out the rotational axis line from the width of the blade, the manufacturing tolerance and repaired areas should be considered. If desired, the horizontal line may be located with the blade on a surface table. The width of the blade is determined by a comparison height gage and the correct dimension from the leading edge is then marked on the blade. After several points are established this way, the height gage may be used to determine if the blade is correctly aligned. Set the blade on a surface table so that the edges of the blade are vertical. The marked rotational axis of the blade should be within plus or minus 1/32 inch for the location shown on the blade drawing.

4.4.3.6.7.7 Methods of Refinishing Beech Aluminum Propeller Blades -

Depending on the type of finish desired, two methods of refinishing the Beech aluminum propeller blades are suggested. They are chromadizing or polishing. These methods as given in detail below, are acceptable, but not mandatory since the proper equipment is not generally available.

Chromadizing will give the same protective finish as anodizing and much the same appearance.

Polishing produces a mirror-like finish which is sometimes desired for an attractive appearance.

After either method is accomplished, it is recommended that a coat of dull black lacquer be applied to the face side of the blade to reduce glare.

4.4.3.6.7.8 Chromadizing - Wet-Wash Method -

NOTE

Requirements for complete cleanliness of metal parts before chromadizing are of absolute necessity. Therefore, removal of all dirt, soil, grease, or finger marks is mandatory for obtaining good results. Any solvent-type cleaner can be used.

(a) Solution - 8 to 10 percent chromic acid by weight.
(b) Mop or swab surfaces with chromic acid solution. Be certain that solution film completely covers surface.

NOTE

If film "breaks" or "runs", surface of metal is not clean.

(c) Temperature - room temperature.
(d) Time - 5 to 10 minutes.

Rinse blades thoroughly in clean water, first cold then hot, and dry. Drying may be accomplished by use of an air blast.

4.4.3.6.7.9 Polishing -
(a) Sand blades smooth first using 400 grit wet or dry emery paper, and finishing up with 600 grit making certain that all scratches have been removed with 600.
(b) Buff blades to a mirror finish using a clean cloth wheel and soap stone. Also acceptable is

PROPELLER BLADE TOLERANCES

| | |
|---|---|
| Blade Length | ±1/16 |
| Blade Width (From shank to Station 24 inclusive) | ±3/64 |
| (From Station 30 to tip inclusive) | ±1/32 |
| Blade Thickness | .025 |
| Blade Alignment | ±1/32 |
| Blade Angle (Shank to Station 18 inclusive) | ±0 30' |
| (Station 24 to Station 30 inclusive) | ±0 15' |
| (Station 36 to tip inclusive) | ±0 12' |
| Longitudinal Location of Stations | ±015 |

a fine grade of rubbing compound used on a clean cloth wheel.
(c) Clean blades thoroughly using a soft cloth and apply a coat of good grade polishing wax and polish. It will be necessary to wax the blades intermittently to prevent oxidation. Waxing intervals will depend on the amount and type of use the blades are subjected to.

4.5 PROPELLER REASSEMBLY -
Before assembling the propeller, all parts are to be carefully inspected, cleaned, and all damaged parts repaired or replaced.

4.5.1 Blade Bearing Race Installation -
If the blade thrust bearing races are to be replaced, care should be exercised that each race is installed in its correct position as shown on the drawing, figure 4-11.
(a) Apply a light coat of MIL-L-7711 grease to the blade seal and install.
(b) Raise the retention nut up off the sleeve and tilt to hold.
(c) Place the two halves of the -2 race together around the sleeve next to the flange.
(d) Place 31 each .4375 diameter balls in the -2 race.
(e) Place the two halves of the -4 race together around the sleeve on top of the balls.
(f) Lower the retention nut of the blade bearing and hand press to seat the -4 race.
(g) Turn blade tip down and drop retention nut part way down the sleeve.
(h) Remove the two halves of the -2 race and pack MIL-L-7711 grease around the balls.
(i) Install the two halves of the -2 race and pull the retention nut up in place.

If the races are not being replaced turn the blade tip down. Drop the retention nut part way down the sleeve, raise the -2 race, install the 31 bearing balls, pack with MIL-L-7711 grease and pull retention nut back up in place.

4.5.2 Blade Counterweight Installation -
The propeller blade counterweights must be installed on the same blade from which they were removed and at precisely the correct angle as shown in figure 4-15. Each counterweight is marked with the blade serial number and each blade sleeve has an etch mark where the counterweight halves come together for the correct angle.
(a) Loosen the set screws in each counterweight half. If the stake impressions will not permit loosening of the set screws, screw them on out and clean out the threads with a 1/4-20NC tap.
(b) Place the counterweight halves together over the small land on the blade sleeve.
(c) Install the two attaching bolts and tighten the nut on the short bolt to 350 inch-pounds torque.
(d) Locate the counterweight halves so they will come together in line with the etch mark on the sleeve.
(e) Snug up the long attaching bolt and pry the counterweights toward the tip. This locates the counterweight in its most outward position.
(f) Tighten the nut on the long attaching bolt to 350 inch-pounds torque. The counterweight halves may have a gap between them. This is acceptable providing neither of the lands on the counterweight halves are riding on the land on the blade sleeve.
(g) Check the position of the counterweight in respect to the etch mark on the sleeve and adjust if necessary. The angle of the counterweight is 78 degrees 15' as shown in figure 4-15.

4.5.4 Hub Worm Gear Installation (See Figure 4-14) -
(a) Apply Permatex Number 2 to the outside diameter of new needle bearing and press to within .000 to .010 inch of top of housing. The bearing must be installed through the inside of the worm gear housing. If the needle bearing is pressed in from the outside the stake impressions on the outside will impress on the outside diameter of the bearing and permit it to leak grease. Examine the top of the needle bearing for cracks or defects that may have occurred when the bearing was pressed in place.
(b) Place the short shank of the worm gear in the needle bearing.
(c) Install lower bearing and secure with the large snap ring that fits in the worm gear housing.
(d) Place spacer in place on the lower bearing and secure with snap ring around the worm gear shank.
(e) Check end play of worm gear. If end play exceeds .025 inch, reduce by changing to a thicker spacer.
(f) Apply Permatex Number 2 to the outside diameter of Metric O.D. seal and press seal in place flush with the end of housing. Care should be exercised that lid of seal is not turned back when seal is slipped over worm gear shaft.
(g) Install snap ring around worm gear shank and hand press worm drive gear in place.
(h) Install worm drive gear attaching bolt and washer. Tighten and safety.

4.5.3 Propeller Low Pitch Adjustment -
(a) Install the solid pitch stops in the hub body.
(b) Install only the worm gears and worm drive gears.
(c) Install the propeller blades (low serial number blade in the same side of the hub as wide spline groove) and check the low pitch at the 36 inch station by turning the worm drive gear until the blade gear hits the solid stop. The low pitch should be 13-1/4 degrees when the blade gear is against the solid stop. If the same stops are used the low pitch can usually be adjusted by relocating the solid stop attaching bolts. If the low pitch is still too low the stop will have to be replaced. If the low pitch is still too high or if new stops have been installed the low pitch end of the stops will have to be cut down until the 13-1/4 degree blade angle is attained. In most instances the angle between the center of the attaching bolt hole and the low pitch end of the stop is 76 degrees. When cutting down the solid stops the end of the stop must have the same shape as it was before the cutoff was made.

4.5.5 Propeller Drive and Pitch Change Gear Installation -
(a) Pack MIL-L-7711 grease in the groove in the bronze bearing in the pitch change gear hub.
(b) Brush a coat of MIL-L-7711 grease on O.D. of the sleeve on the drive gear and place the pitch change gear on the sleeve.
(c) Install clamp ring and clamping screw but do

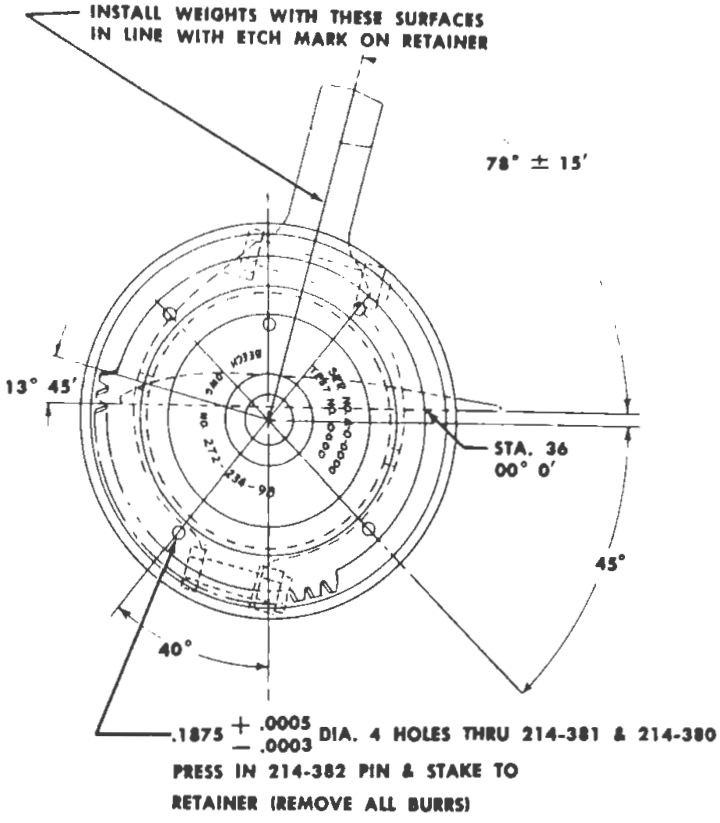

INSTALL WEIGHTS WITH THESE SURFACES
IN LINE WITH ETCH MARK ON RETAINER
78° ± 15'
13° 45'
STA. 36
00° 0'
45°
40°
.1875 + .0005 − .0003 DIA. 4 HOLES THRU 214-381 & 214-380
PRESS IN 214-382 PIN & STAKE TO
RETAINER (REMOVE ALL BURRS)

Figure 4-15. Blade Segment Gear and Counterweight Installation

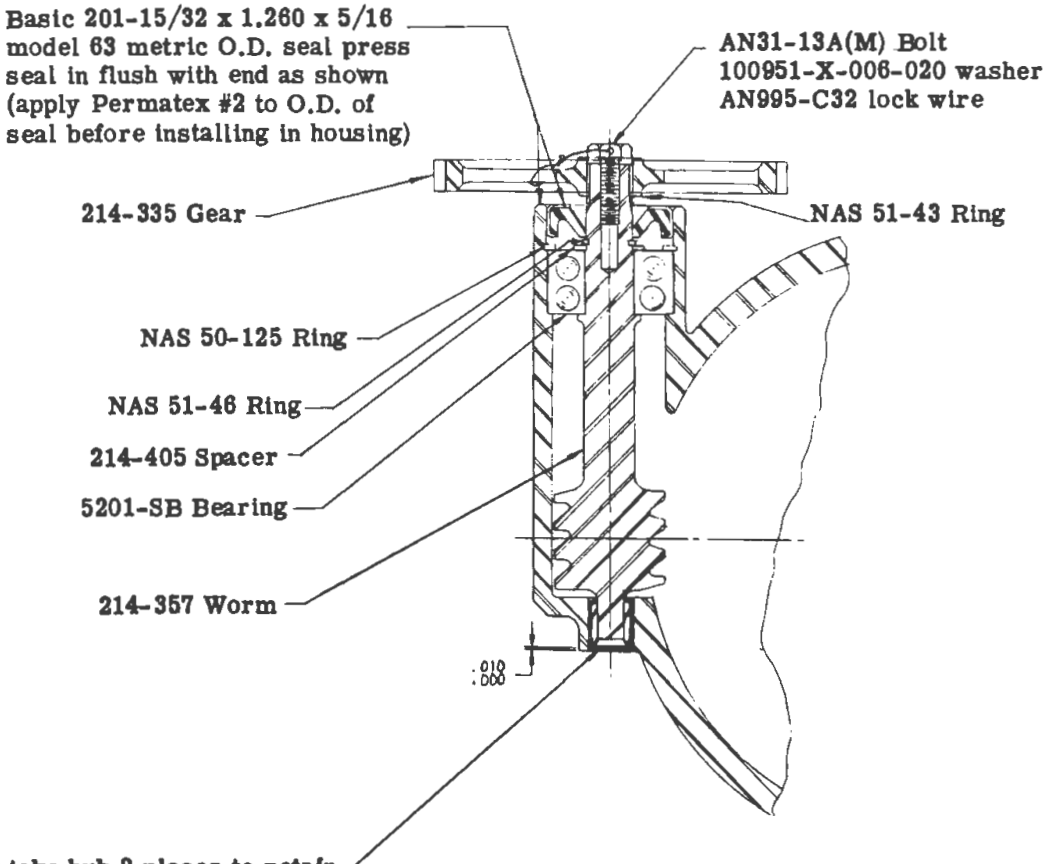



Figure 4-16. Hub Worm Gear Installation

not tighten screw.
(d) Place the drive and pitch change gear unit on the propeller hub and carefully mesh the worm drive gears, making sure both blades are against their low pitch stops.
(e) Align the holes in the sleeve of the drive gear with the holes in the hub, install the attaching screws, tighten and safety to each other.
(f) Turn the clamp ring so the wide area on it will clear the hub and snug up the clamping screw until the ring cannot be turned by hand.

4.5.6 Spinner Bulkhead Installation -
(a) Place spinner bulkhead over the external gears locating the brackets numbered 1 and 2 on the hub lugs numbered the same.
(b) Install the four attaching bolts with two washers each placing the chamfered washer under the head of the bolt with the chamfer to the bolt head.
(c) Tighten the bolts to 70 to 100 inch-pounds torque.
(d) Check normality of spinner bulkhead to the bore of the hub. The surface that mates with the spinner and to which the rubber strips are cemented must be normal to the center line of the front bronze bushing and the rear cone seat of the hub within .040 TIR.

4.5.7 Balance -
Each propeller blade is balanced individually. This single blade balance procedure results in a perfectly balanced propeller blade both horizontally and vertically at two different blade angles matching a master blade. Lead is added to the hole in the shank of the blade and to the balance ring on the blade sleeve to bring each blade into the same balance and the number 3 is marked in front of the blade serial number on the blade decal. In this respect all new blades are interchangeable.

When two new blades are installed in a hub assembly and the propeller assembly balanced the correction for perfect balance must be made on hub assembly. Eight "T" nuts are provided on the spinner bulkhead for the purpose of adding bolts and washers to achieve perfect propeller balance and to locate the spinner when it is installed. The lead in balance ring of the new blade must not be disturbed when balancing the propeller . To do so may result in a rough propeller even though the static balance is all right.

After a blade has been repaired it will be necessary to correct its balance to match with the opposite blade, or if both blades have been repaired the blades should be matched to each other. In either event, unless a repaired blade is balanced to match a new blade, the weight Category Number 3 should be crossed out.

4.5.8 Single Blade Balance -
A repaired blade should either be balanced to an unrepaired blade or a new blade and both must be equipped with counterweight, balance ring, lubricated bearing and the hole in the shank of the blades full of MIL-L-7711 grease. The balance ring on the blade to be balanced should be empty of lead.

Install the blades in the hub to be used and set each blade at approximately 13 degrees measured at the 36-inch station. Both blades must be set exactly the same. Balance the blade horizontally using a single piece of lead of the required weight molded to fit the contour of the balance ring and lying loosely on the balance ring; then balance the blade vertically in the upright position with another piece of lead of the required weight lying loosely on the balance ring 90 degrees to axis of rotation. If more than 1/2 a ring full of lead is required for horizontal balance pack lead wool in the hole in the center of the shank of the blade.

In most instances the piece of lead required to balance the blade horizontally will be larger than the piece required to balance the blade vertically. However, if the piece for vertical balance is the larger the condition must be corrected by removing the lead, if any, from the hole in the center of the blade or changing to a lighter counterweight. To achieve the best balance results, more weight must be required for the horizontal balance than for the vertical balance.

After the weight required for horizontal and vertical balance is determined, measure the arc of the lead pieces on a four-inch protractor. Lay aside the piece used for vertical balance and subtract the number of degrees it measured from the number of degrees of the lead piece required for horizontal balance. Equally divide the remainder and add one half to the amount required for vertical balance.

| | |
|---|---|
| Lead required for horizontal balance | 102° |
| Lead required for vertical balance | 50° |
| Remainder | 52° |
| One half of remainder | 26° |

Lead required for balance - One piece 50° + 26° = 76° and one piece 26°.

Lay the cut pieces of lead on the balance ring of the light blade and double check for horizontal balance. Lay the cut pieces of lead 180 degrees apart on the balance ring and double check for vertical balance. Locate the lead accurately for perfect vertical balance with the blade angle at approximately 13 degrees. Mark the position of the lead and change the blade angle of both blades to approximately 84 degrees. Adjust the lead until the vertical balance is perfect at this blade angle. If adjustment was necessary mark and check the vertical balance again at the same low blade angle first used. Repeat as necessary until the vertical balance at both blade angles is perfect. Mark the position of each piece of lead and the position of the balance ring on the blade sleeve. Remove the balance ring and solder the lead in place. When the lead is soldered in place the added weight of the solder is intentional for minor final balance corrections.

Reinstall the balance ring on the blade sleeve and locate it according to the mark. Pry balance ring to its extreme position toward the tip and tighten the attaching screws. Recheck the horizontal and vertical balance. The horizontal balance should show the

blade to be slightly heavy but this must be corrected last. If either of the vertical positions (low pitch and high pitch) is out of balance, drill out lead equally about the center line of rotation from the heaviest side or rotate the balance ring slightly. If the horizontal balance is heavy, drill out equal amounts of lead from each of the two pieces of lead added. The drillings must be located 180 degrees apart.

4.5.8 Matching Blade Balance -

When matching propeller blades to balance with each other the single blade balance procedure is used. The location of the lead in the balance ring and the balance ring on the blade being used as the master blade must not have been disturbed since the blade left the factory. Correct the balance of only one blade, matching it with the other and cross out the weight category number on the decal on both blades. This situation should only be encountered when the propeller diameter is reduced, otherwise each blade should be balanced to a new blade.

4.5.9 Propeller Assembly Balance -

The propeller is balanced as a complete assembly less grease and the spinner shell. Minor corrections are usually all that are necessary if the blades have been balanced individually. To accomplish the propeller assembly balance attach AN960-416 washers and AN74A-3, -4 or -5 magnafluxed bolts as required to the "T" nuts of the aft side of the spinner bulkhead until the propeller is perfectly balanced horizontally, vertically and diagonally. Bolts used must have a minimum of 1/4 and a maximum of 1/2 thread engagement on "T" nut. A maximum of six bolts of all dash numbers may be used.

After final balance remove the propeller blades and pack one pound of MIL-L-7711 grease to each side of the hub. Reinstall the propeller blades and establish the blade torque. When reinstalling the blades air will be trapped in the hub preventing the blade retention nuts from tightening. The air can be released by working a piece of .010 inch shim stock between the retention nut and blade sleeve and working the blade back and forth. Remove the shim stock when hydraulicing is no longer present.

4.5.9 Blade Torque -

Tighten the blade retention nut until all play between the blade sleeve and the retention nut disappears. Loosen the retention nut approximately 2 of the notches on the retention nut until a slight amount of play is evident. Install the retention nut locks, tighten the bolts and safety.

4.6 TRANSMISSION REPAIRS -

Since replacement of gears requires adequate testing equipment and the work must be done under the direct supervision of a competent technician

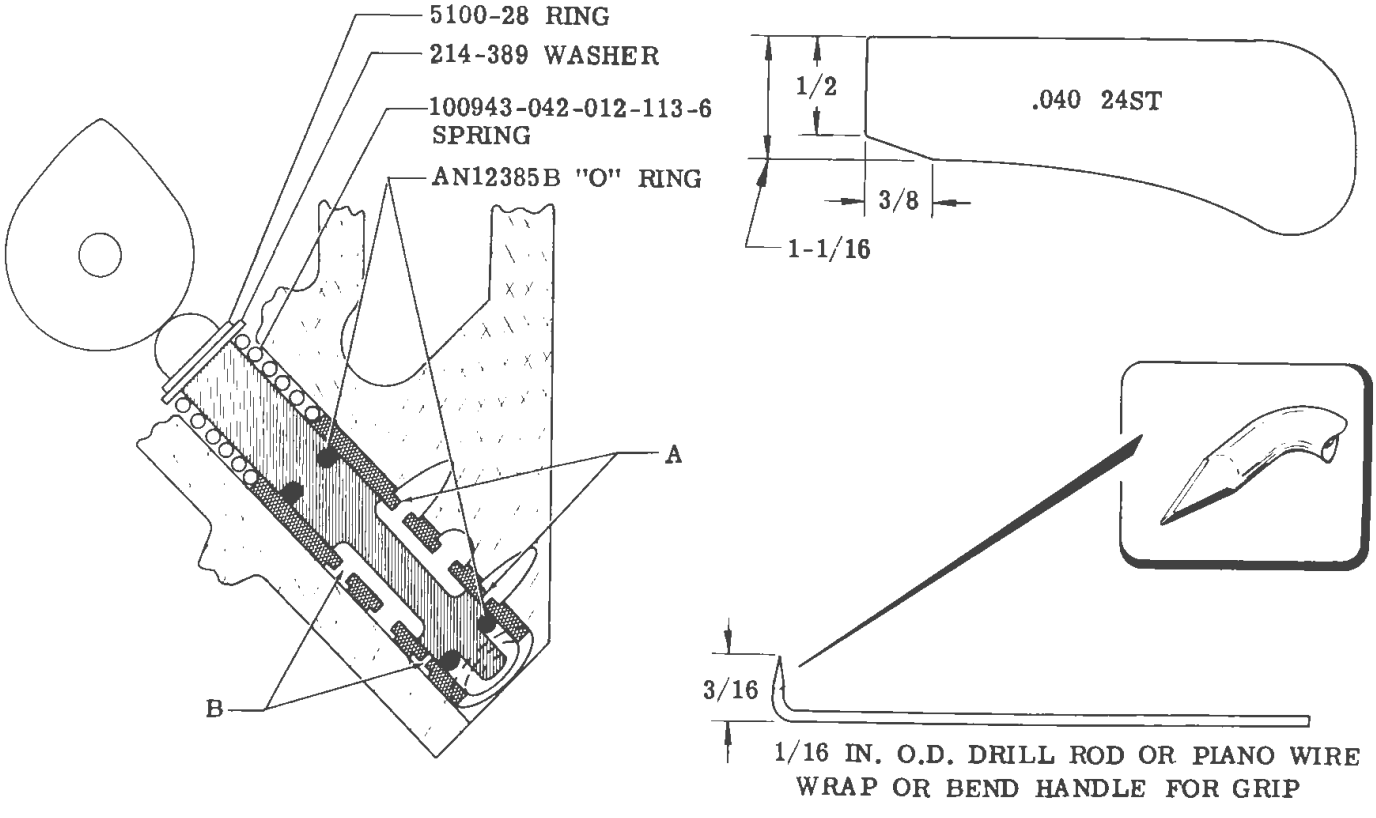



Figure 4-17. Low Pitch Stop Valve Repair

who is thoroughly familiar with the unit, this work should be done at the factory only. The equipment required is beyond the means of most repair stations, since the limited number of transmissions in service make it unlikely that the cost could be recovered in major repairs. Major repairs not specifically described in this manual will be made at the factory; exchange reconditioned transmissions can be supplied on request.

Authorized transmission repairs should be under the direct supervision of competent personnel having been familiarized with the unit. Repairs to the transmission must be accomplished in a dust and dirt free area and extreme care taken that no foreign particles come into contact with the assembly. Complete disassembly and overhaul may not be accomplished in the field.

Repairs and replacement of the external parts on the transmission may be made without functional testing equipment; however, should the transmission not function properly on the airplane further investigation and repairs should be accomplished where adequate test equipment is available. When repairing the low pitch stop valve plunger or replacing oil seals follow the applicable disassembly and assembly instructions.

Complete transmission overhaul will be accomplished at normal engine overhaul or replacement periods, but not to exceed a total of 1000 hours of operation.

4.6.1 Transmission Disassembly -

The following are transmission disassembly instructions for repairs and replacement of parts. Each transmission component must go back into the same transmission assembly except for the necessary replacement parts. It is advisable to tag each part with the transmission serial number to keep separate from parts of other transmissions:

(a) Disconnect the electrical harness from the feathering motor and the limit switches. Mark each wire so they will go back on the same location.

(b) Remove limit switches and limit switch actuators.

(c) Note position of valve plunger on cam and remove cams, cam locks, spacers and keys.

(d) Remove the electric feathering motor and coupling.

(e) Remove the front mounting bracket.

(f) Remove the transmission front plate with the external gears and gear train.

(g) Remove the planetary gear cage and shaft assembly.

(h) Remove the snap rings securing the bearing in the front plate and remove the front plate from the external gear assembly.

(i) Remove the seal and bearing from the front plate.

(j) Remove the snap rings and spacers from the pitch change gear shaft and remove the bearing, differential gear and spacers in this order. Remove the pitch change gear from the drive gear.

(k) Remove the seal and bearings from the drive gear.

(l) Remove the plug located opposite the electric motor and remove the snap ring securing the bearing located therein.

(m) Remove feathering motor driven gear and forward bearing.

(n) Remove the feathering motor driven gear aft seal, snap ring and bearing.

(o) Remove the snap ring from the housing at the end of the idler gear shaft and using a 5/32 inch diameter rod, press the shaft out toward the opening for the feathering motor.

(p) Remove the idler gear with the bearings and the spacer within it.

(q) Remove the snap ring, bearing and seal from the cam drive shaft.

(r) Remove cam drive shaft, gear, key, spacer and bearing.

(s) Remove snap ring washer and spring from end on low pitch stop valve and plunger and remove the plunger.

CAUTION

Do not disassemble the transmission any further than outlined in the above instructions.

4.6.2 Cleaning -

All parts except snap rings, seals and needle bearings must be thoroughly cleaned in an approved noncorrosive cleaning solution. Do not use abrasives or cleaning devices that may score, scratch or remove the parent material. Dry the parts with an air blast and lay them out for inspection. If the parts are to lie idle for some time they must be protected with a light coat of anti-corrosive compound. The anti-corrosive compound must be removed and the parts recleaned prior to assembly.

4.6.3 Inspection -

All parts must be clean and dry for the visual inspection. Carefully examine all parts for galling, cracks, burrs and other obvious irregularities.

4.6.4 Bearing Inspection -

Most of the bearings are the anti-friction type. The ball bearings will be checked for damaged balls, races, retainers and any evidence of overheating. If they pass this inspection they may be considered satisfactory for continued usage. The needle bearings will be replaced whenever they are removed from assembly. Any bearing that has been removed in a detrimental manner or by pressing on only one race will be rejected. Clearances between ball bearing races and shafts or housings shall be generally acceptable up to .002 inch.

4.6.5 Low Pitch Stop Valve Repairs -

These repair instructions should be followed when it is observed that the low pitch stop valve plunger is sticking and does not ride on its cam. The repair must be accomplished with the transmission removed from the airplane. Before proceeding with the repair, spare 5100-28 snap rings, AN123858 O-ring seals and special tools shown in figure 4-17 should be readily available.

Typical operational indications of a stick-

plunger are propellers out of synchronization, continuous rpm oscillation, and slow or sometimes no response to the propeller control directing propeller into increase rpm.

4.6.6 Repair Instructions -
(a) Remove propeller and transmission.
(b) Place the narrow block shown in figure 4-17 between the cam drive shaft and the washer on the end of the plunger, compressing the spring slightly.
(c) Remove the snap ring from the end of the plunger with Truarc No. 2 pliers.
(d) Remove the block, push the plunger back off the cam and remove the washer and spring.
(e) Remove the plunger and remove its seals.
(f) Using crocus cloth, polish surface of plunger that mates with valve sleeve. The clearance between the plunger and valve sleeve must not exceed .001 inch; therefore, use caution that no more than .0005 inch is removed in the polishing. The polishing may be accomplished on a turning lathe or similar method. Do not bend or warp the plunger nor radius the sharp edges at points "A", figure 4-17.
(g) Clean out valve sleeve and remove any sharp edges or burrs at location "B", figure 4-17, with the special tool shown in figure 4-17. Insert the point of the tool in the slots in the valve and with several twisting movements the sharp edges and burrs will be removed.
(h) Polish out valve sleeve with crocus cloth. This polishing operation may be accomplished with a 1/4 inch diameter drill rod chucked in a drill motor and the crocus cloth wrapped on the end of the rod. Again use caution that excessive material is not removed to exceed maximum clearance of .001 inch.
(i) Using a squirt oil can, shoot some light weight engine oil into the fitting for the increase rpm port in the oil motor cap. Direct the nozzle of an air hose into this same fitting and blow it out with clean dry air under 75 to 100 pounds of pressure. Repeat this cleaning out process at least three times. The fitting for the increase rpm port is the fitting nearest to the valve sleeve.
(j) Place the plunger in the valve sleeve and check to determine if the plunger will fall through by its own weight. Several checks should be made rotating the plunger slightly for each trial. If the valve sticks at any time check plunger for warping.
(k) Apply a coat of engine oil in the valve sleeve and on the plunger.
(l) Install new O-ring seals on the plunger and carefully slip the plunger in the valve sleeve to prevent damage to the seals as they pass over the small openings.
(m) Place spring and washer on plunger and block up with the narrow block.
(n) Install a new snap ring and remove the block.
(o) Install transmission and propeller.

4.7 TRANSMISSION REASSEMBLY -
(a) Install low pitch stop valve plunger with new seals and install spring washer and new snap ring in this order over the cam end of the plunger.
(b) Partially install cam drive shaft in the housing and install drive gear, key and spacer in this order over the end of the shaft. The hub end of the drive gear must be against the spacer.
(c) Insert cam drive shaft in bearing and install new seal, bearing and snap ring in this order in the open end of the housing.
(d) Place the idler gear in its relative position, line up the spacer within it and install the idler gear shaft with new seals and secure with snap ring.
(e) Install feathering motor driven gear bearing in the cap opening of the housing. Secure with snap ring and install cap.
(f) Install feathering motor driven gear in bearing while engaging idler gear. Install bearing, snap ring and new seal in this order over the motor drive gear shaft in the motor opening of the housing.
(g) Install bearing and seal in this order, in the large opening in the drive gear (large external gear). If needle bearing was removed install in the smaller opening of the drive gear and locate inside the gear shaft 1/16 inch from outside edge.
(h) Install pitch change gear (small external gear) in the drive gear and install in this order bronze spacer, differential gear, bearing snap ring,aluminum spacer, snap ring, aluminum spacer and snap ring over the gear shaft.
(i) Check axial end play of pitch change gear in drive gear. End play must be between .010 and .025 inches. This is adjusted by changing to different thickness bronze spacers.
(j) Install seal, bearing and snap ring in the front housing plate.
(k) Install pitch change gear and drive gear assembly in front housing plate and secure with snap ring around drive gear shaft at the bearing in the front housing plate.
(l) Place planetary gear and shaft assembly on the shaft of the pitch change gear and drive gear assembly and install complete assembly in the transmission housing. Do not force the assembly in the housing. Slowly turn the external gears until the assembly falls in place.
(m) Install front mounting bracket and all attaching nuts for the bracket and the front plate and safety.
(n) Install low pitch stop valve cam, key, large spacer, unfeathering cam (large cam) serrated washer, key spacer, serrated washer, key, feathering cam washer and nut in this order on cam drive shaft.
(o) Install limit switch and secure with attaching nuts.
(p) Install coupling and electric feathering motor.
(q) Install harness, attaching each wire to the terminal at the same location as it was when removed.
(r) Turn external gears until the low pitch stop plunger is in the same approximate position on its cam as it was prior to removal of cams.

If the engine was stopped with the propeller in low pitch then the cam will now have the plunger at the approximate low pitch stop position or if neither the propeller or transmission external gears were turned after removal, the transmission will be set approximately as it was when removed. When installing a transmission after disturbing its hydraulic low pitch setting the propeller should be set at a slightly higher pitch setting than it was when removed to prevent the propeller from hitting the solid low pitch stops and excessively hard wearing on the external gears. When running a propeller and transmission in this condition, there will be a distinct whining noise

and the engines should be shut down immediately.

4.7.1 Transmission External Gears -

Wear on the transmission external gears will also be determined by measuring the circular tooth thickness. The maximum reduction of the circular tooth thickness at the overhaul period and during service use is the same as for the propeller external gears.

The minimum circular tooth thickness of the 272-221 gear which shall be cause for replacement during overhaul is .150 and the minimum circular tooth thickness of the 272-221 gear which shall be cause for replacement during service use is .144 inch. The addendum is .040 inch. The minimum circular tooth thickness of the 272-202 gear which shall be cause for replacement during overhaul is .0912 inch and the minimum circular tooth thickness of the 272-202 gear which shall be cause for replacement during service use is .0852 inch. The addendum is .0625 inch.

NOTE

The placard on the 272-202 gear stipulating a backlash tolerance of .004 to .014 does not apply to service wear on gear teeth. The backlash tolerance applies to new installations only.

4.8 Propeller and Transmission Installation Adjustments -

Propeller low pitch adjustments will depend on how the transmission low pitch stop is set. If the low pitch stop cam is in the closed position turn the propeller pitch change gear approximately 10 teeth off of the propeller blade low pitch solid stop before installing the propeller on the crankshaft. Check the static rpm.

If the transmission low pitch stop cam is not in the closed position hold the transmission drive gear and manually turn the transmission pitch change gear until the plunger rides approximately 1/16 inch from the high spot on the cam. This is approximately the closed position of the low pitch stop valve. Turn the propeller pitch change approximately 15 teeth off of the blade low pitch solid stop before installing the propeller on the crankshaft. Check the static rpm.

4.8.1 Static RPM Adjustment -

Warm up the engine with the propeller control in the full increase position until the cylinder head temperature and oil temperature are in the green arc. If a distinct whining from the propeller is heard, shut the engines down and adjust the propeller low pitch further off of the blade low pitch solid stop. With the engines warmed up, open the throttle to approximately 2300 rpm and exercise the propeller with the propeller control. Place the propeller controls in the full increase position and open the throttles all the way. The static in both engines should be together and between 3200 and 3250 rpm. Exercise the propeller at the static rpm and note the engines rpm and any difference when the propeller control is back in the full increase position. Retard the throttles to approximately 2200 rpm and open them once more for the final static rpm check. Adjustments are made by moving the propeller off the shaft enough to disengage the transmission external gears and turning the pitch change gears as required.

Each time the propeller low pitch is changed, back the propeller pitch change gear against the blades low pitch solid stop and count the number of teeth on the pitch change gear. At least three teeth must remain between the low pitch solid stop and the actual propeller low pitch for the desired static rpm. If less than three teeth will remain, the engine is sluggish and should be examined and corrected or the governor high rpm stop is out of adjustment.

4.8.2 Feathering and Unfeathering Limits -

After the propellers have been adjusted for a satisfactory static rpm, shut down the engine and adjust the feathering and unfeathering limits shortly thereafter.

Level the crankshaft and turn the propeller blades in the horizontal position. Connect all electrical connections if they were disconnected and turn on the master switch. Move the propeller control past the detent to the feathering position and then back to the detent. Check the blade angle at the 36 inch station when the electric feathering motor stops. The blade angle should be between 44-1/2 and 45-1/2 degrees and the point of contact between the cam and the switch actuator roller must be within the "open-closed" area marked on the cam. Loosen the lock nut on the end of the cam drive shaft and adjust largest cam to click the switch off at this point.

Move the propeller control to the feathering position and check the blade angle at the 36 inch station when the motor stops. The blade angle should be between 83-1/2 and 84-1/2 degrees and the point of contact between the cam and the switch actuator roller must be within the "open-closed" area marked on the cam. Loosen the lock nut on the end of the cam drive shaft and adjust the smallest cam to click the switch off at this point.

Looking at the nut end of the cam drive shaft adjust the feathering cam clockwise to break the circuit sooner and adjust the unfeathering cam counterclockwise to make it break the circuit sooner. Never tighten or loosen the cam lock nut without holding the spacer located between the two cams. To do so may damage the cam drive gear and result in a transmission failure. The limit switches are wired normally closed; if the feathering motor is not energized during the adjustment procedure the cam may have the switch clicked off.

4.8.3 Governor and Control Linkage Adjustments -

Governor adjustments ordinarily will be limited to adjusting the hydraulic feathering mechanism to advance or delay the feathering action of the hydraulic motor with respect to the travel of the governor arm, or adjusting the high rpm stop to increase or decrease the take-off rpm. These are covered in the following readjustment sequence.

When a component of the propeller control linkage is replaced the entire linkage should be checked and if necessary readjusted in a definite sequence. To check for the proper static rpm proceed as follows:

(a) Set the propeller control lever approximately 1 8 inch from the forward end of the slot in the control console and tighten the friction lock.

(b) Set the governor arm against the high rpm stop. The low pitch stop adjustment screw, as originally set, should not be disturbed.

(c) Adjust the rod ends on the linkage to maintain the high rpm position and install the attaching bolts. If sufficient adjustment cannot be obtained at the rod ends, loosen the clamp at the firewall and pull the cable housing through far enough to obtain the necessary adjustment.

(d) Check travel of the control lever to insure full travel of the governor arm between stops.

(e) Pull the feathering circuit breaker in the left-hand subpanel, set the propeller control lever in the high rpm position and start the engine. After the engine has warmed up to normal operating temperature, exercise the propeller several times and advance the throttle to full open position.

(f) Check the static rpm. If the static rpm is not 3200-3250 when the governor arm is against its high rpm stop, check the synchronization of the propeller with the transmission as outlined in the paragraph, Static RPM. If the hydraulic cam stops the propeller according to the limits given, and all possible carburetion and ignition troubles have been eliminated, adjust the governor high rpm stop. If this is to no avail replace the governor.

4.8.4 Control Detent Stop Adjustment -

After the proper static rpm is obtained, the low rpm stop, consisting of a cam and detent behind the instrument panel, may be adjusted as follows:

(a) Make sure the feathering circuit breaker has not been reset.

(b) With the engine running and the propeller in high rpm, move the propeller control toward low rpm and advance the throttle until 2100-2150 rpm is obtained with a manifold pressure of approximately 24 inches hg. The propeller control should be at the upper edge of the begin unfeathering mark on the control quadrant.

(c) On obtaining the above setting, leave the propeller control in position and stop the engine with the mixture control. If hydraulic feathering starts prematurely, turn the square-end screw on top of the governor clockwise just enough to start feathering slightly below 2100 rpm

(d) Loosen the lock nuts on the cam actuating rod and adjust the cam to come into contact with the detent.

(e) Tighten the lock nuts.

(f) Start engine and check the rpm at the point where the stop is felt on the control. If the stop is not felt at 2100-2150 rpm, it must be readjusted.

4.8.5 Hydraulic Feathering Adjustment -

After the low rpm stop has been set proceed as follows to adjust the hydraulic feathering:

(a) Pull the propeller control lever back until the detent of the low rpm stop is just over the highest portion of the cam in the propeller control linkage. Hydraulic feathering should begin at this point.

(b) If necessary, turn adjusting screw (8, figure 5-28) counterclockwise to begin the hydraulic feathering action sooner or clockwise to begin the hydraulic feathering later.

If hydraulic feathering action occurs prematurely, it will be necessary to move the propeller control lever into the constant speed range between adjustment checks to prevent complete feathering of the blades.

(c) A positive stop must be felt at the low rpm end of the constant speed range of the propeller control lever before any feathering action takes place.

## 4.9 OIL SYSTEM -

Each engine incorporates a wet sump pressure-type oil system with an oil pump in the engine, and a thermostat and an oil cooler for automatic temperature control. Capacity for each engine is three US gallons. Oil cooler radiators are mounted in the lower engine cowling of each nacelle and are cooled by ram air passing through the forward air entrance opening in the cowling. The oil temperature is controlled automatically by thermostat-type valves that by-pass oil around the radiator until the engine oil is warmed to operating temperature.

### 4.9.1 Oil Radiator -

4.9.1.1 Removal -

(a) Drain engine oil sump.

(b) Disconnect flexible hose at the oil radiator.

(c) Remove the bolts retaining the oil radiator.

4.9.1.2 Installation -

(a) Place oil radiator in position for installation.

(b) Install retaining bolts and tighten.

(c) Connect flexible inlet and outlet hose.

## 4.10 FUEL SYSTEM -

The fuel system of the Model B-50 provides a total capacity of 135 US gallons in four fuel cells. These cells are located in the outboard wing and wing center section. The cells in the center section have a capacity of 42.5 US gallons each and are considered the main tanks. The cells in the butt of the outboard wing have a capacity of 25 US gallons each and are used as auxiliary tanks. The inboard tanks are interconnected through the fuel selector in such a manner as to provide cross-feed from either inboard fuel tank to either or both engines. An electric fuel booster pump in each inboard fuel cell provides a positive fuel flow in all flight attitudes, also serving as an emergency fuel booster pump in the event of failure of an engine-driven fuel pump. The carburetors are pressure type; excess fuel from the carburetors is returned to the inboard fuel cells.

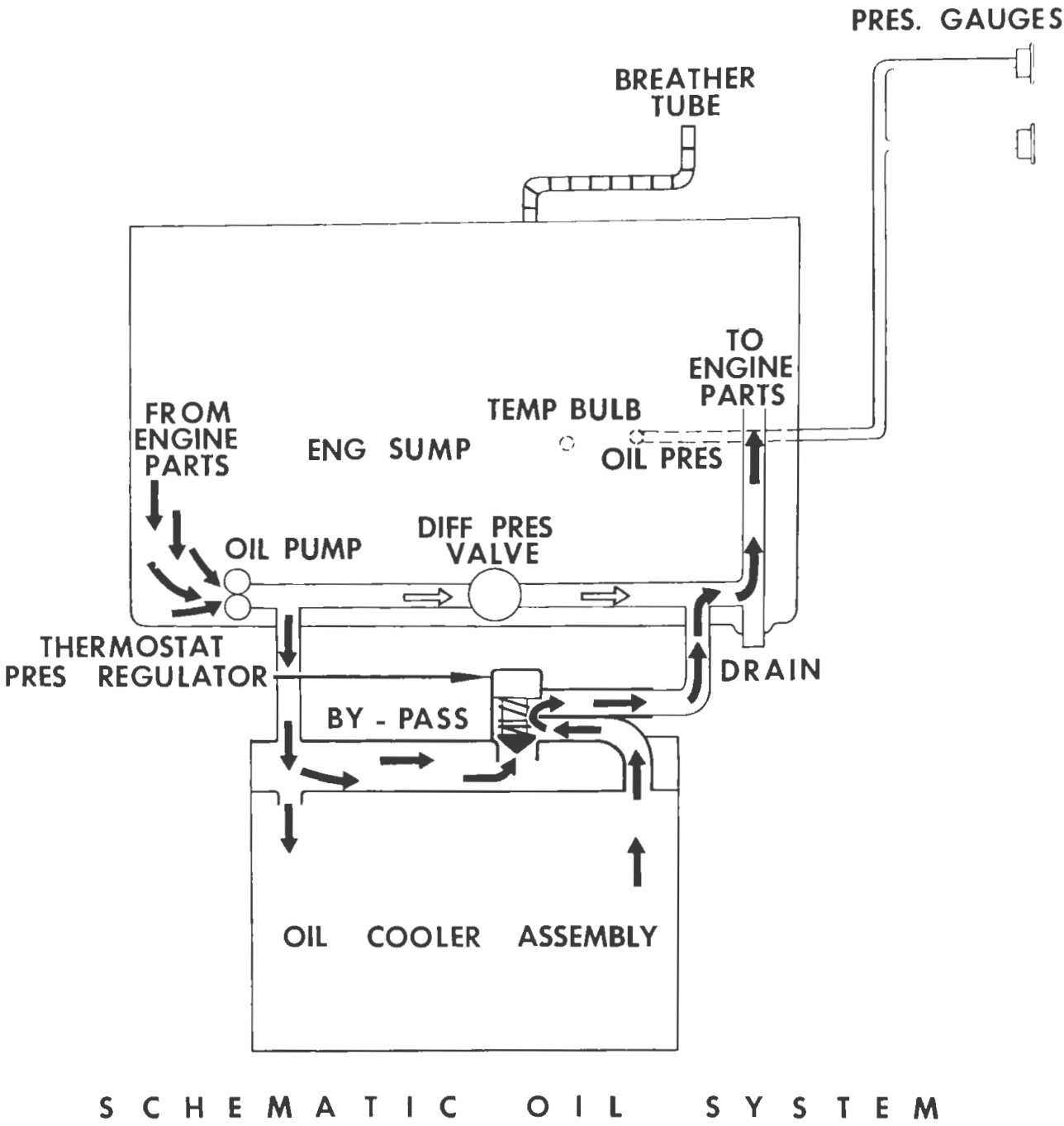



Figure 4-18. Oil System Schematic

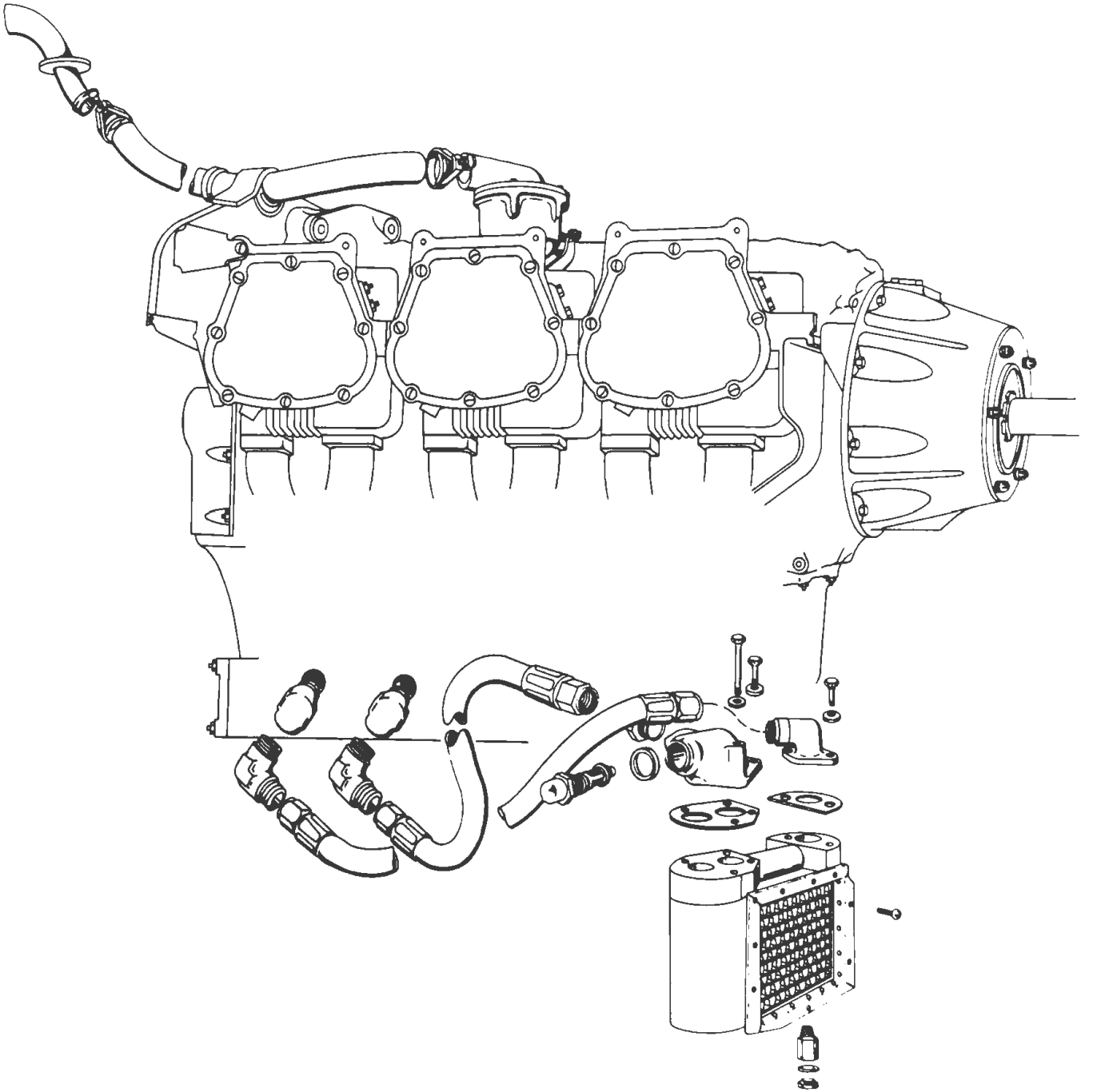


Figure 4-19. Oil System Perspective

4.10.1 Wing Fuel Cells (Inboard) -

4.10.1.1 Removal -

The inboard fuel cell may be removed in the following manner:

(a) Turn fuel selector valves and battery master switches "OFF".

(b) Drain the cell to be removed by locking open the quick drain fitting on the fuel booster pump.

(c) Remove the fuel indicator transmitter access cover on top of the center section.

(d) Disconnect the electrical lead to the fuel indicator transmitter.

(e) Remove the screws which attach the fuel indicator transmitter to the fuel cell and remove the transmitter.

(f) Remove the bolts that attach the fuel tank filler neck to the airplane structure and remove the filler neck.

(g) Remove fuel cell access plate on lower surface of the center section.

(h) Disconnect electrical leads and fuel outlet line from submerged fuel booster pump.

(i) Remove the bolts attaching the fuel pump to the tank and structure and remove the pump.

(j) Disconnect the fuel tank vent and carburetor return lines.

(k) Unsnap the seven snaps which attach the fuel cell to the upper skin of the wing.

(l) Collapse the fuel cell and remove through the lower access hole.

NOTE

If the fuel cell is to be stored for a prolonged period of time, it is advisable to coat the inside of the tank with engine oil to prevent deterioration.

4.10.1.2 Minor Repair -

No damaged area larger than 2 inches may be repaired. Cells with damage on the radius or in the fitting area must be returned to the manufacturer for repairs. Lesser damage may be repaired with U.S. Rubber Company repair set US538N, applying a patch to each side of the cell wall as follows:

(a) Cut a piece of synthetic rubber coated fabric (U.S. Rubber 3136 outside repair material) large enough to exceed damaged area by at least 2 inches in all directions. Buff lightly and thoroughly with No. "0" sandpaper and wash with methyl ethyl ketone (U.S. Rubber Company 3339 solution) to remove buffing dust.

(b) Cement buffed side of patch with two coats of black rubber cement (Minnesota Mining and Manufacturing Company EC-678S). Allow each coat to dry 10 to 15 minutes.

(c) Buff and clean outside of cell area to be patched as in Step (a).

(d) Apply two coats of cement to buffed area, allowing each coat to dry 10 to 15 minutes.

(e) Freshen cemented areas of patch and cell with methyl ethyl ketone.

(f) While still "tacky", apply one edge of patch to cell. Holding remainder of patch away from cell, roll or press down from a half inch to an inch of patch at a time with roller or blunt instrument, being careful not to trap air between patch and cell.

(g) Apply one seal coat of cement approximately 1 inch wide over entire edge of patch.

(h) After outside patch has cured for a minimum of six hours, pull damaged area through the large fitting opening, if possible, to make application of the inside patch easier.

(i) Cut a piece of Buna N Nylon sandwich material (U.S. Rubber Company 5063) the same size as the outside patch. The side opposite the red fabric side will be cemented.

(j) Buff and clean the mating areas of patch and cell as in Step (a) and apply two coats of cement to each, allowing each coat to dry 10 to 15 minutes.

(k) Freshen cemented areas with methyl ethyl ketone and apply patch as in Step (f).

(l) Remove red fabric from patch by moistening with methyl ethyl ketone.

(m) Apply two seal coats of cement approximately 1 inch wide over edge of patch, allowing the first to dry 15 minutes and the second coat 12 hours or more so that the patch will not stick to other areas of the cell.

(n) After the cell has been reinstalled in the airplane, test for leakage by completely filling with fuel. If no leakage is indicated after 30 minutes, the cell is ready for service.

4.10.1.3 Installation-

(a) Collapse the fuel cell and install through the fuel cell access door in the lower center section skin.

(b) Snap the seven snaps that hold the top of the fuel cell to the upper skin.

(c) Install the submerged fuel booster pump and gaskets. Install the attaching bolts and torque to 25 inch-pounds. Safety the bolts together using steel safety wire.

(d) Attach electrical connection to fuel pump.

(e) Install the filler neck and gasket in the fuel tank. Install the attaching bolts and torque to 50 ± 5 inch-pounds. Safety bolt heads together.

(f) Install the fuel indicator transmitter. Tighten screws and safety.

(g) Connect electrical leads to the fuel transmitter.

(h) Connect fuel outlet, fuel tank vent, and carburetor fuel return lines.

(i) Check fuel transmitter as outlined in Paragraph 4.10.3.3.

(j) Fill tank and operate fuel pump. Check for evidence of leaks at fittings.

(k) Check fuel pressure on pilot's fuel pressure gage. The fuel booster pump alone should furnish a pressure of 9 psi. If not, adjust the pump as outlined in Paragraph 4.10.4.4.

(l) Install all access panels.

4.10.2 Wing Fuel Tank (Outboard) -

4.10.2.1 Removal -

The outboard wing fuel tank may be removed as follows:

(a) Turn fuel selector valve off.

(b) Drain the wing fuel tank by locking the quick drain fuel cock open.

(c) Remove access cover on top of the wing.

(d) Remove the fuel transmitter.

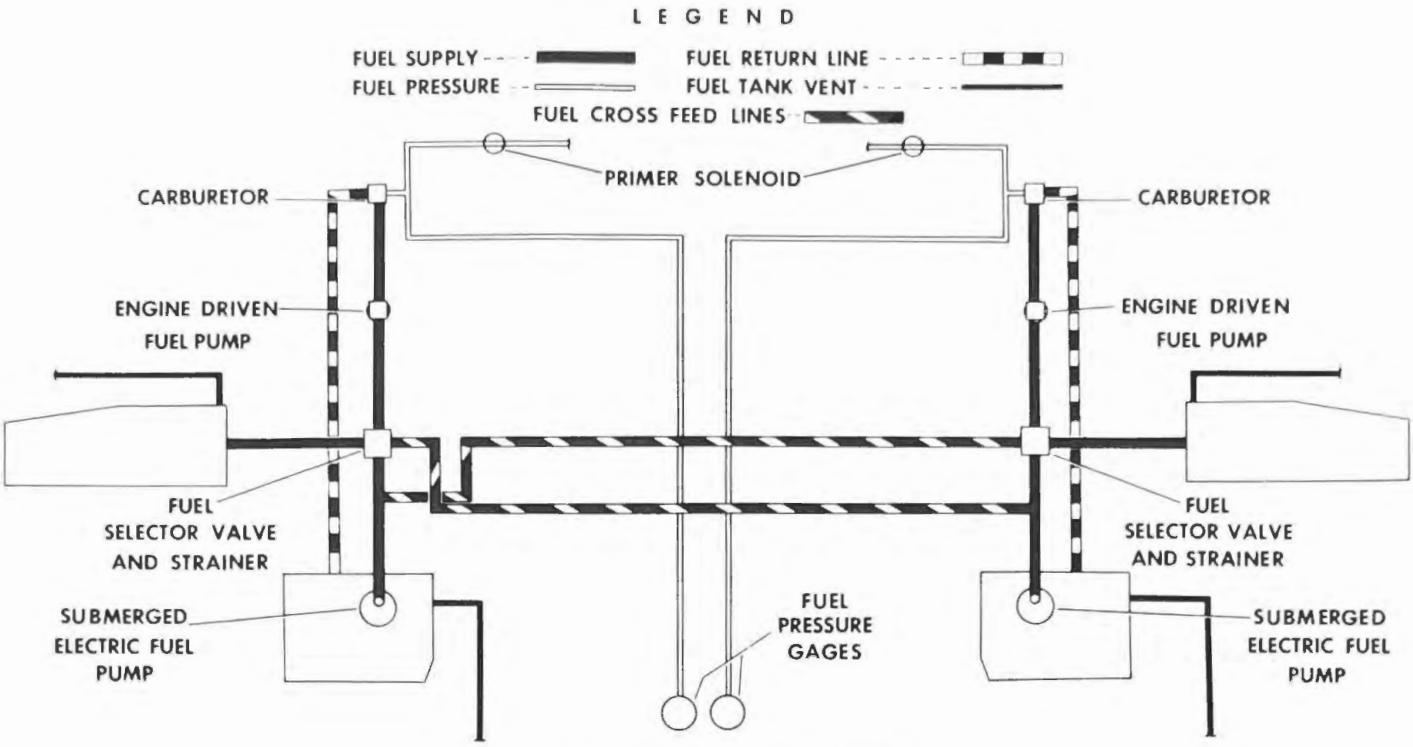



Figure 4-20. Fuel System Schematic

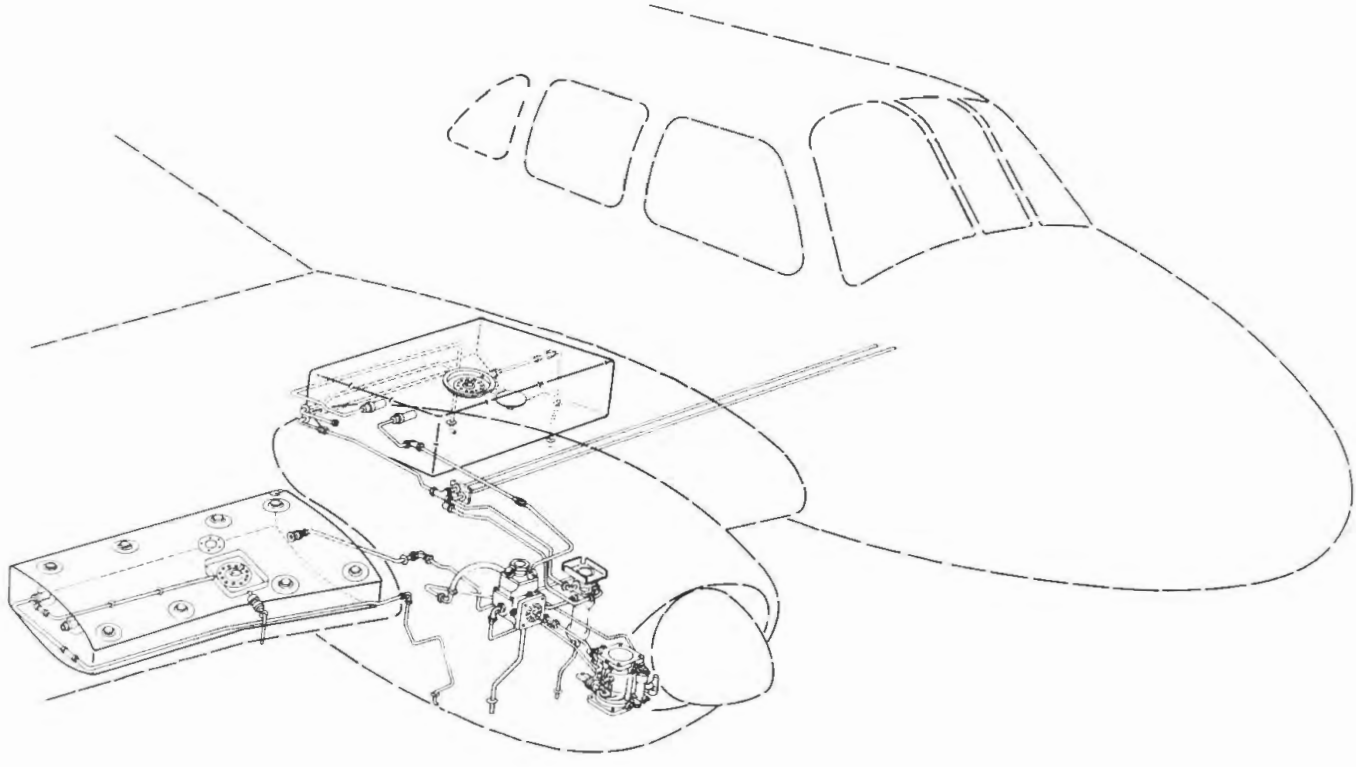


Figure 4-21. Fuel System Perspective

(e) Remove the bolts that attach the filler neck to the tank and scupper drain pan.
(f) Remove screws attaching the scupper drain pan to the wing skin and remove the drain pan.
(g) Unsnap the snap fasteners which hold the top of the cell to the upper wing skin.
(h) Disconnect the fuel outlet and tank vent lines. Access to these lines is gained by removing the augmenter tube from the nacelle.
(i) Collapse the fuel cell and remove through the access hole.

NOTE

If the tank is to be stored for a prolonged period of time it is advisable to coat the inside of the tank with engine oil to prevent deterioration.

4.10.2.2 Minor Repairs -
See Paragraph 4.10.1.2.

4.10.2.3 Installation -
Installation of the fuel cell may be accomplished in the following manner:
(a) Collapse the fuel cell and install in the wing through the fuel cell access door.
(b) Snap the fasteners that hold the fuel cell against the lower surface of the upper wing skin into place.
(c) Install the scupper drain pan and connect the fuel tank overflow line.
(d) Install the filler neck and gasket using drilled head bolts. Torque the bolts to 25 inch-pounds and safety using steel safety wire.
(e) Install the fuel indicator transmitter using drilled head machine screws. Safety using steel safety wire.
(f) Connect vent lines and outlet lines.
(g) Connect electrical leads to the fuel indicator transmitter.
(h) Check the fuel indicator transmitter as outlined in Paragraph 4.10.3.3.
(i) Fill the tank and check all lines and fittings for evidence of leaks.
(j) Install access opening covers.

4.10.3 Fuel level Indicator Transmitter -

4.10.3.1 Removal -
(a) Remove access cover over top of fuel cell.
(b) Remove the electrical connections to the transmitter.
(c) Remove its five screws which attach the transmitter to the fuel cell.
(d) Remove the transmitter. Care must be used to avoid bending the float wire.

4.10.3.2 Installation -
(a) Install the transmitter in the cell.
(b) Install five retaining screws.
(c) Install electrical leads to transmitter.
(d) Safety retaining screws.
(e) Install access cover.

4.10.3.3 Testing the Fuel Level Transmitter -
(a) Turn battery master switches "ON".
(b) With float resting on the bottom of the cell, check the gage for empty reading.

NOTE

Check the bottom of the cell to be sure it is not raised and lifting the float to give an inaccurate gage indication.

(c) Manually raise the float to the top of the cell and check the indicator for full reading.

4.10.3.4 Adjusting the fuel Level Transmitter -
(a) If tank reading is low for the amount of fuel in the tank, bend the wire down slightly.
(b) If the tank reading is high for the amount of fuel in the cell, bend the wire up slightly.
(c) After completing the above operation, check the transmitter at both ends of the scale to be sure that correct readings are obtained in both the full and empty tank conditions.

4.10.4 Adjusting Liquidometer System -
The four potentiometers, located on the back side of the fuel control panel permit adjustment of the fuel quantity indicator to 0 readings. No adjustment of the potentiometers should be attempted until the fuel transmitter has been checked. When the float is against the top of the tank, the fuel quantity indicator should read full and with the float resting on the bottom of the tank, the fuel quantity indicator should read empty. With all float mechanism checked, fill all tanks with fuel and calibrate the indicators as follows:
(a) Remove screws attaching the fuel control panel to the structure and pull panel away far enough to work with a screw driver and wrench in the rear of the panel.
(b) Adjust each of the four potentiometers on the back side of the fuel indicator panel for its maximum resistance by loosening the lock nut on the end of the shaft housing and turning the slotted shaft counterclockwise (as viewed from the back side) to the limit of its travel.
(c) Apply 28 to 28.5 volts to the airplane's main bus distribution system, either by running an engine above the generator cut-in speed or by using external power.

NOTE

For maximum accuracy of the fuel level indicators in flight, it is essential that the full voltage flight condition be simulated as in step c.

(d) Check all fuel gages at this point. They should read approximately 1/2 to 3/4 full.
(e) Readjust the four potentiometers by slowly turning each shaft in a clockwise direction until its corresponding gage indicates full.
(f) Tighten the lock nut on each shaft to maintain the calibrated position.
(g) Shut down engine or remove external power, leaving only battery power connected to the bus system. With the voltage reduced to approximately 24 volts, the fuel indicators will show a corresponding drop. This change in indication is normal and no attempt should be made to correct it.

4.10.4.1 Submerged Fuel Booster Pump -

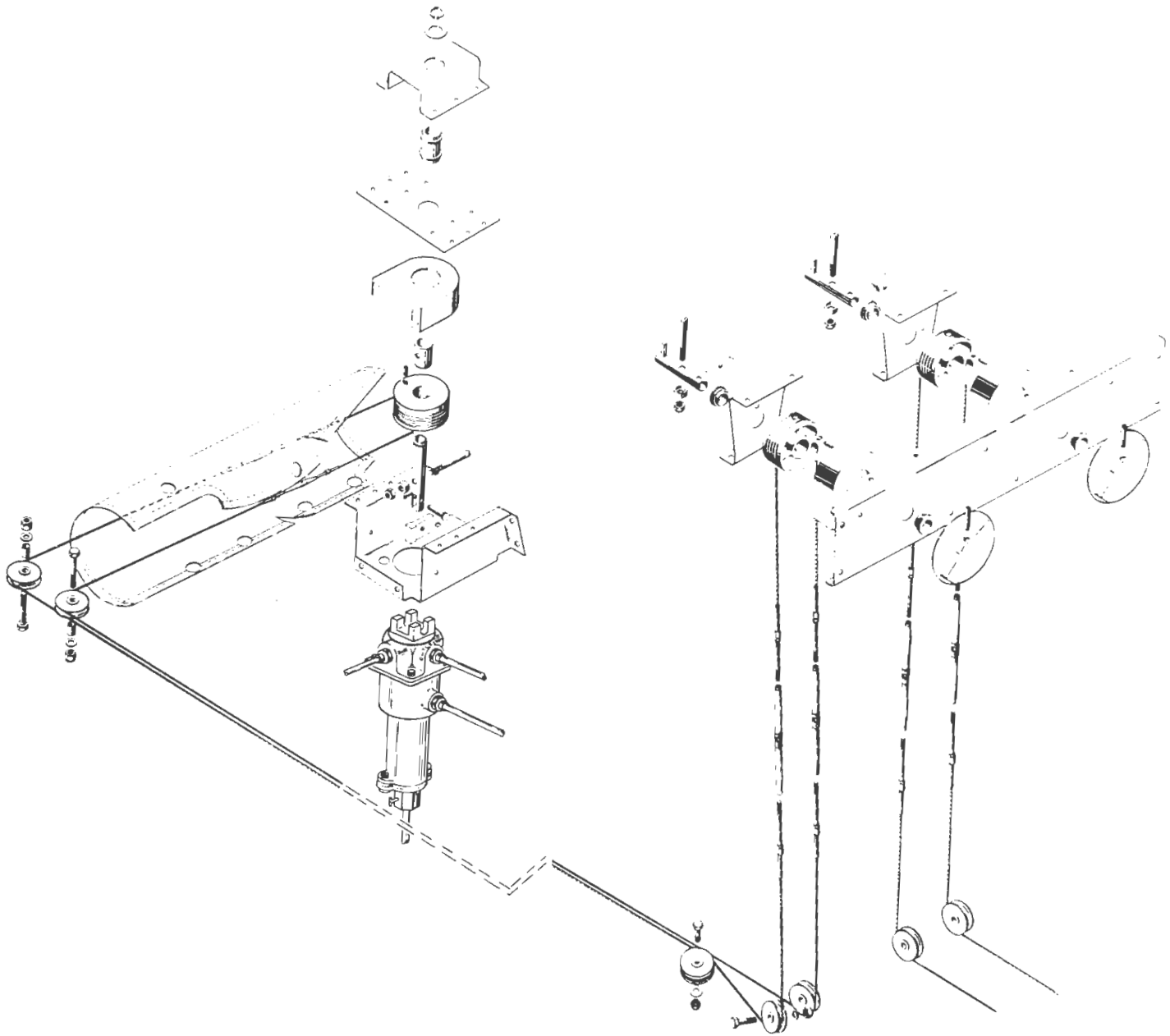


Figure 4-22. Fuel Selector System

4.10.4.2 Removal -
(a) Remove access cover on lower wing skin.
(b) Drain fuel cell by opening quick drain cock.
(c) Disconnect electrical leads at the booster pump.
(d) Remove the booster pump attaching bolts.
(e) Remove pump.

4.10.4.3 Minor Repairs -
Field repair is limited to replacement of brushes and cleaning of commutator. The commutator should be cleaned with clear, unleaded gasoline.

4.10.4.4 Installation -
(a) Place pump and gasket in position in fuel tank sump and install bolts.
(b) Torque bolts to 25 inch-pounds and safety, using steel safety wire.
(c) Connect electrical leads.
(d) Fill fuel tank and check operation of pump.
(e) Check attaching area and fuel lines for evidence of leakage.
(f) Check booster pump fuel pressure adjustment. Fuel pressure on the booster pump should be nine pounds.

4.10.4.5 Adjustment -
Adjustment of the fuel booster pump may be accomplished by removing the plate on the lower side of the center section to gain access to the pump. Remove safety wire on the adjusting screw check nut. Loosen the check nut and with the fuel pump operating, adjust the fuel pressure to nine psi. Turn the adjusting screw in to increase the pressure and out to decrease the pressure.

4.10.5 Engine Drive Fuel Pump -

4.10.5.1 Removal -
(a) Turn fuel selector valves off.
(b) Disconnect the fuel inlet and outlet lines.
(c) Disconnect the fuel pump drain line.
(d) Remove the four nuts holding the fuel pump to the engine.

4.10.5.2 Installation -
(a) Install pump and gasket.
(b) Install nuts that hold the pump to the engine.
(c) Connect the fuel pump drain lines.
(d) Connect the fuel inlet and outlet lines.

4.10.5.3 Inspection and Adjustment -
(a) Turn fuel and fuel booster pump on. Check the connections at the engine driven pump for leaks.
(b) With the engine running at 1800 rpm, adjust the pressure relief valve on the bottom of the fuel pump to 11 to 14 pounds fuel pressure. After adjusting, check the pressure with both the fuel booster pump on and the engine operating, to see that the pressure does not go over the red line.

4.10.6 Fuel Selector Valves -
The fuel selector valves are located in the wheel well on the aft side of the firewall and are controlled from the cabin fuel selector panel through a series of cables. The selector valve is so constructed that it also serves as a fuel strainer and with the valves properly positioned, it serves as a fuel cross-feed.

4.10.6.1 Removal -
Removal of the fuel selector valve and strainer is accomplished by removing the canvas protective boot and disconnecting the fuel lines from the selector. (The fuel tanks must be drained or the fuel tank lines plugged to prevent fuel loss). After disconnecting the fuel lines, remove the four bolts which attach the lower mounting bracket to the firewall mounting bracket.

4.10.6.2 Installation -
To install the fuel selector and strainer, align the fuel selector valve so it is in the position indicated by the fuel selector handle; then install and bolt to the firewall mounting bracket. Check operation of the selector to see that the valve is fully engaged and is in the same position as the fuel selector handle in the cabin. Connect the fuel lines and install the canvas boot.

4.10.6.3 Rigging -
Rig the fuel selector system as follows: Set the fuel selector valve in the nacelle to the "OFF" position, then set the selector valve handle in the cabin in the "OFF" position. Remove the access panel under the fuel selector pan and rig the cables to 10 ± 2 pounds. Care must be used to see that both the selector handle and the selector valve remain in the "OFF" position during the rigging operation. After completion of the rigging operation, check to be sure that selector handle and selector valve positions correspond when turned to each tank.

4.10.7 Carburetor -
The carburetor used on this power plant installation is the Bendix Model PS-5BD. It is a pressure-type, diaphragm carburetor and because of its construction has non-icing characteristics. Automatic altitude mixture control is also provided.

4.10.7.1 Removal -
(a) Disconnect throttle, mixture control, and fuel lines at the carburetor.
(b) Remove bolts attaching the carburetor air scoop.
(c) Remove four nuts attaching the carburetor to the engine crankcase mounting pad.

4.10.7.2 Installation -
(a) Assemble carburetor and gasket to engine crankcase and install the four retaining nuts.
(b) Connect the throttle control and carburetor mixture control.
(c) Connect fuel lines to carburetor.
(d) Check for full travel of throttle and carburetor mixture control. Adjust as required.
(e) Install carburetor air scoop, tighten bolts and safety.
(f) Operate booster pump and check all fittings at carburetor for fuel leaks.

4.11 CARBURETOR AIR INTAKE SYSTEM -
Filtered air is provided for the carburetor through use of an air maze type filter located in the

lower engine cowling.

4.11.1 Air Filter -

4.11.1.1 Removal -
(a) Remove screws which hold the air intake access cover on the lower cowling. Remove cover.
(b) Slide filter out through access hole.

4.11.1.2 Cleaning and Servicing -
(a) Using cleaning solvent and spray type cleaning equipment, flush filter screen until thoroughly cleaned.
(b) Dry filter fully. Use of an air blast will aid in removing excess cleaning solvent from the filter screen.
(c) After filter is fully dry, saturate in clean engine oil. Allow excess oil to drain from the filter before reinstalling.

4.11.1.3 Installation -
(a) Slide air cleaner into position.
(b) Install access cover and retaining screws.

4.11.2 Air Scoop and Alternate Air Source -
This airplane is not equipped with a conventional carburetor heater, but uses the heated air of the engine compartment as an alternate air source for carburetor heat and for use in the event impact ice closes the air intake.

4.11.2.1 Removal -
(a) Disconnect alternate air source control.
(b) Loosen clamp attaching the flexible duct to the air intake.
(c) Remove drilled head bolts attaching the air scoop to the carburetor.

4.11.2.2 Installation -
(a) Align holes in air scoop and carburetor.
(b) Install the drilled head attaching bolts and safety.
(c) Connect the control and rig as required.

4.12 EXHAUST SYSTEM.
The exhaust system of the airplane is greatly simplified by the use of a gasoline cabin heater in lieu of an exhaust type heater and by using the jet augmenter with straight stacks from the exhaust ports to the augmenter tube.

4.12.1 Removal of Exhaust Stacks -
(a) Loosen clamps connecting the stacks.
(b) Remove the nuts attaching the exhaust stack to the cylinder.

4.12.2 Removal of Exhaust Augmenter -
(a) Remove screws attaching the augmenter cover plate to the engine nacelle and remove cover plate.
(b) Remove two clamps attaching the augmenter tube to the nacelle and remove the augmenter.

4.12.3 Installation of Exhaust Stacks -
(a) Install stack and gasket. Tighten nuts securely. Torque on the exhaust stack retaining nuts should be 75 to 100-inch-pounds. Avoid overtightening as it deforms the exhaust stack flange and causes leaks.
(b) Install clamps that hold the three stacks together.

4.12.4 Installation of Exhaust Augmenter -
(a) Slide the augmenter into position and install the clamps.
(b) Install the augmenter cover plate on the engine nacelle.

4.13 ENGINE COOLING SYSTEM -
The engine is pressure-cooled by air admitted at the front of the engine cowling and directed with baffles around the cylinders. Jet exhaust augmenters are used to induce airflow through the engine compartment and to evacuate the heated air. This device eliminates the necessity for controllable cowl flaps. As in any pressure-cooled engine, it is imperative for proper cooling that the engine baffles are all properly installed and fitted.

4.13.1 Removal of Engine Baffles -
(a) Intercylinder baffles are removed by removing the jam nut and nut from the attaching bolt and removing the baffle from the lower side of the cylinder.
(b) The rear baffle is removed by removing the attaching screws from the rear cylinders and accessory case. It will be necessary to remove the magneto fingers from the magneto and thread them through the rear baffle.

4.13.2 Minor Repair -
Minor repair of the engine baffle may be made by the ordinary methods used in any type of metal repair as long as the baffle is not deformed to the extent that it will no longer properly fit the cylinder.

4.13.3 Installation of Engine Baffles -
(a) Place the intercylinder baffle in position on the lower side of the cylinder, then place the small attaching bracket on the upper side of the cylinder and install the bolts, spring, nut, and jam nut.
(b) Place the rear baffle in position and attach with screws at the cylinder heads and accessory case. Thread the ignition wires through the baffle and reinstall in the case.

4.14 IGNITION SYSTEM -
Each engine is equipped with two Scintilla magnetos, one S6-LN-50 and one S6-LN-51. The S6-LN-51 is installed on the left-hand side and is equipped with an impulse coupling to aid in starting. Champion RC-26S spark plugs with a .025 gap are approved for the engine. To eliminate radio interference, the ignition system is completely shielded.

4.14.1 Magneto -

4.14.1.1 Removal -
(a) Remove six magneto electrodes from magneto cover by unscrewing knurled retaining nuts.
(b) Disconnect the switch ground connection at the magneto.
(c) Remove the two magneto retaining nuts and remove the magneto.

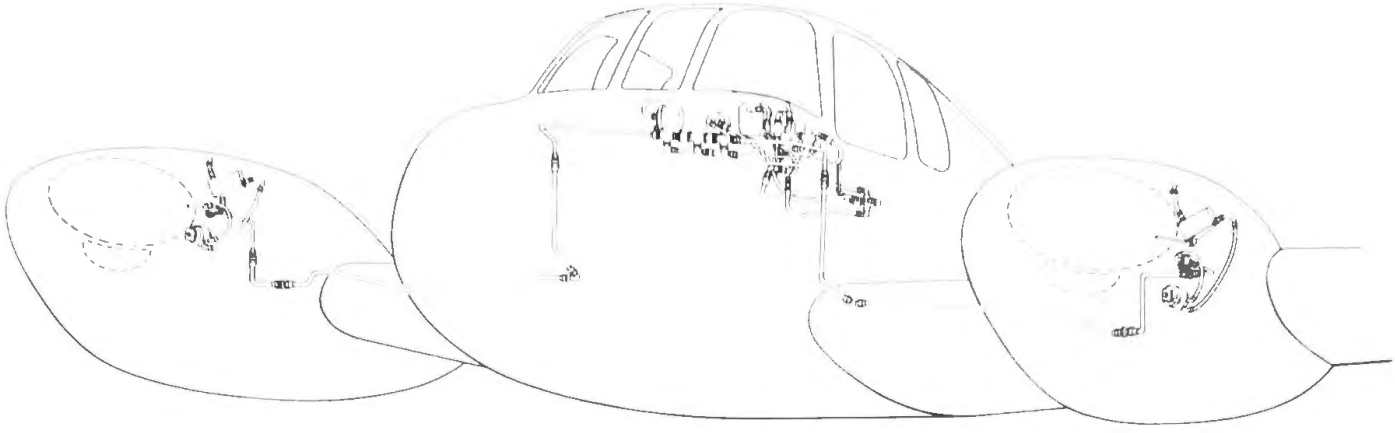


Figure 4-23. Vacuum System

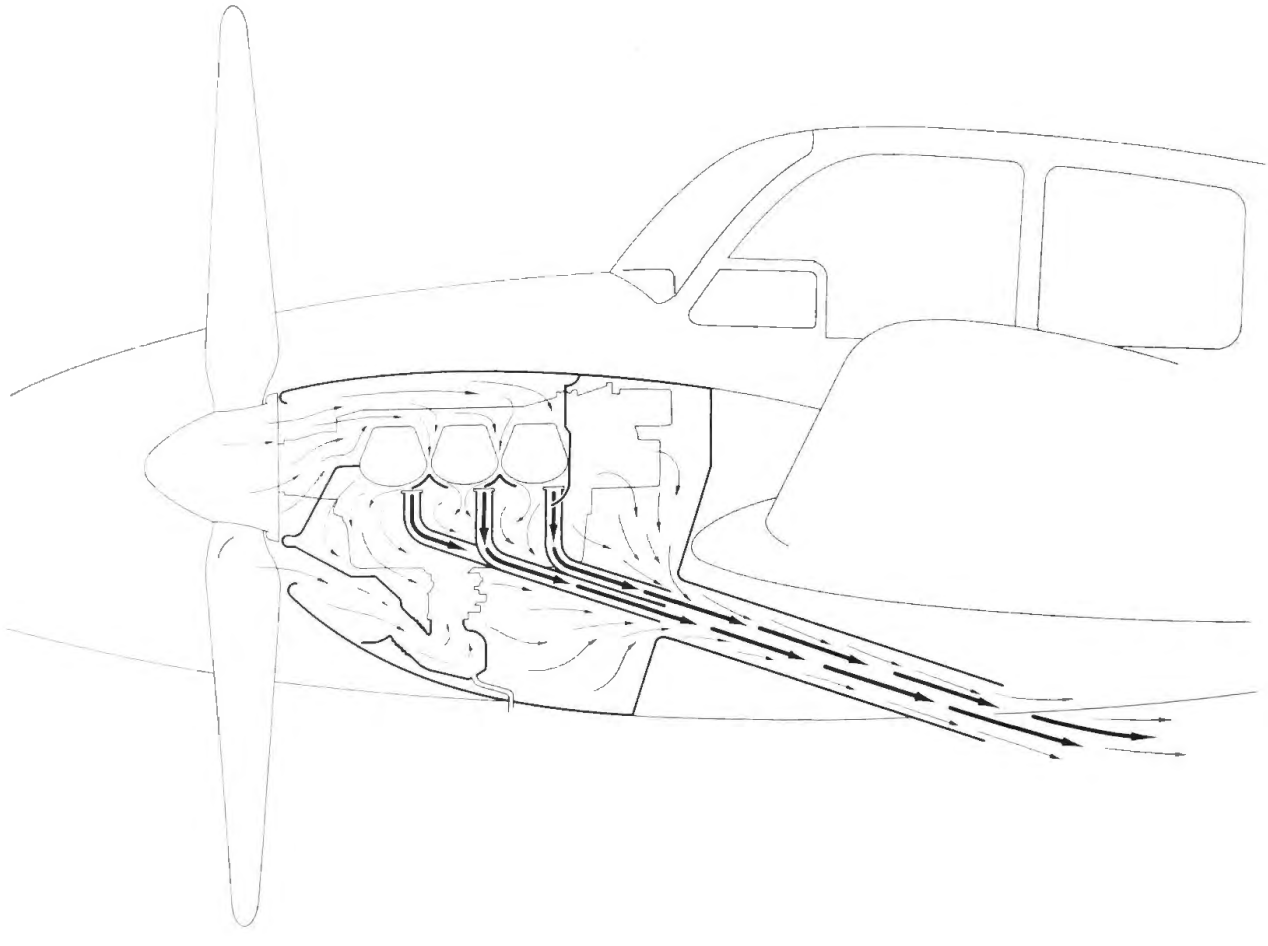


Figure 4-24. Engine Cooling

4.14.1.2 Bench timing of the magneto is accomplished by adjusting the point so they are just beginning to open when the marked tooth on distributor gear is aligned with the pointer in the magneto. timing window.

4.14.1.3 Installation -
(a) Remove the adapter plug from the top of the nose case. This opening is the engine timing window.
(b) With the engine on the compression stroke of Number 1 cylinder, align the timing mark etched on the ring gear with the pointer in the timing window.

NOTE

When timing this engine, if the crankshaft is turned past the timing point in the direction of rotation, it is advisable to turn the engine opposite the direction of rotation to approximately 28 degrees before top dead center then turn in the direction of rotation to the timing point to remove the error caused by gear backlash.

(c) Remove the cap on the top cover of the magneto.
(d) Align marked tooth on distributor gear with pointer in the window of the magneto cap.

NOTE

When timing the left magneto, it will be necessary to turn the magneto shaft until the impulse coupling releases, turn the shaft back past the timing mark, then return to the timing mark.

(e) Install magneto gasket on engine mounting pad.
(f) Install magneto, maintaining setting described in Paragraph 4.14.1.3 (d) above.
(g) Install retaining nuts and washers and tighten enough to hold magneto in position.
(h) Rotate magneto through range of elongated mounting holes until the pointer and marked distributor gear tooth are exactly aligned when viewed through the window on top of the distributor cap.
(i) Tighten magneto retaining nuts.
(j) Reinstall timing window covers on engine and magnetos.

4.15 VACUUM SYSTEM -
To provide suction to operate flight instruments, each engine is equipped with a vacuum pump. To prevent oil loss, an oil separator is installed in the discharge line of each pump.

Check valves are incorporated in the system to seal the inoperative pump in the event of a pump failure. A vacuum gage and selector valve provide a check on either pump.

4.15.1 Vacuum Pump -

4.15.1.1 Removal -
(a) Disconnect the inlet and outlet lines from the pump.
(b) Remove the nuts holding the vacuum pump to the accessory section and remove the pump.

4.15.1.2 Installation -
(a) Place pump and gasket in position on accessory case and install the retaining nuts.
(b) Connect the inlet and outlet lines to pump.

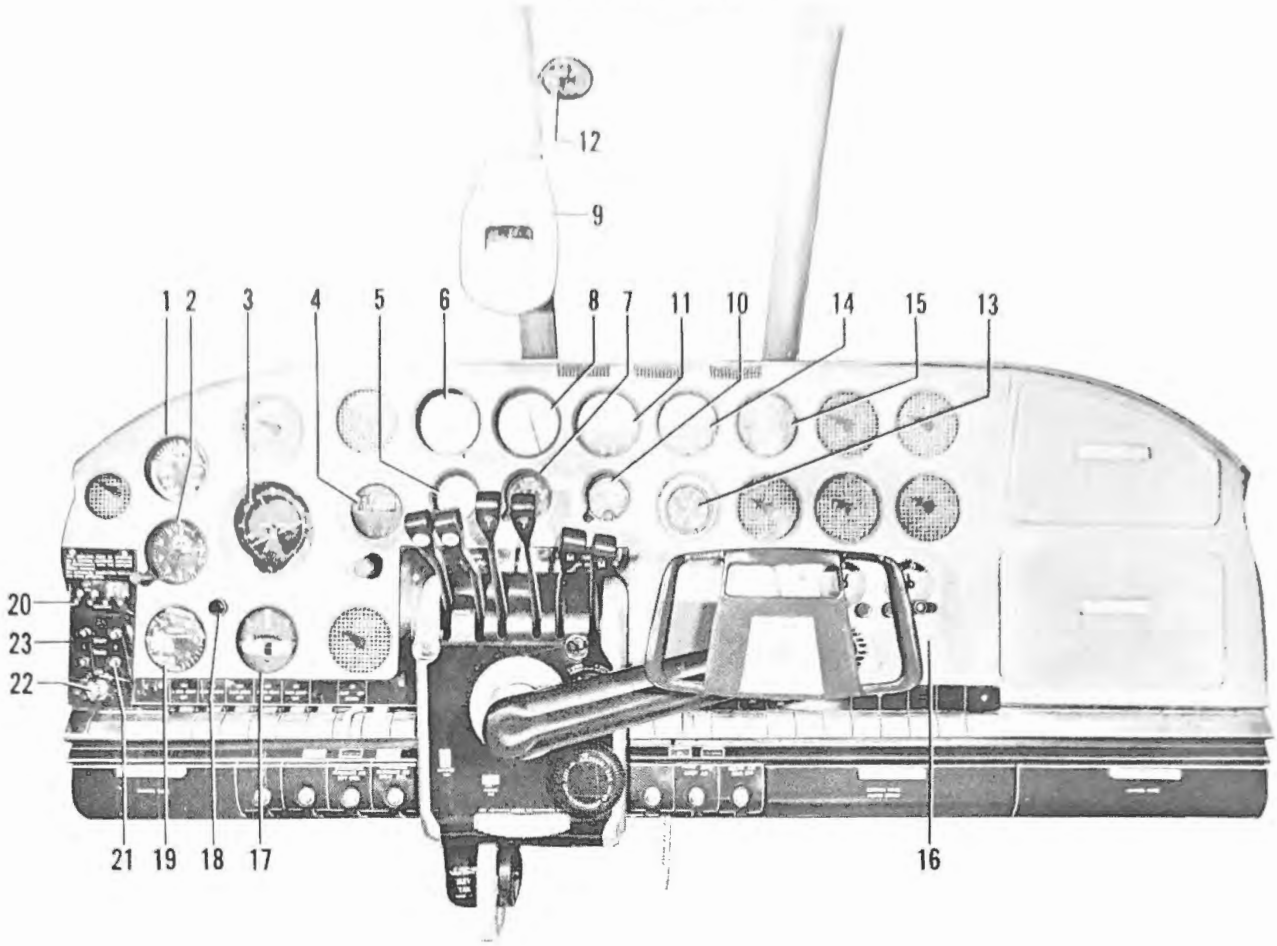
4.15.2 Oil Separator -

4.15.2.1 Removal -
(a) Disconnect inlet, exhaust, and oil return line from the separator.
(b) Remove the two bolts attaching the separator to the nacelle firewall.

4.15.2.2 Installation -
(a) Install the bolts that attach the separator to the nacelle firewall.
(b) Connect inlet, exhaust, and oil return line to the separator.

CHART 4-1. TROUBLE SHOOTING - 272 101 PROPELLER.

| TROUBLE | PROBABLE CAUSE | CORRECTION |
|---|---|---|
| 1. Feathering action slows to a stop before fully feathered position reached. Unfeathering action, if any, extremely slow. | a. Circuit-breaker tripped. | a. Reset. |
| | b. Open circuit. | b. Check continuity: circuit breaker to feathering switch; feathering switch through applicable circuit and limit switch to motor; motor to ground. |
| | c. Defective switch. | c. Check operation of feathering switch and applicable limit switch. |
| 2. Propeller rotates forward after feathering action completed. | a. Electric motor inoperative. | a. Check above causes and correct as necessary. |
| | b. Feathering cam operates early. | b. Readjust. |
| 3. Propeller rotates backward after feathering action completed. | a. Feathering cam operates late. | a. Readjust. |
| 4. Circuit breaker keeps tripping. | a. Grounded circuit. | a. Check for ground between: circuit breaker and feathering switch; feathering switch and applicable limit switch; limit switch and motor. |
| | b. Motor overloaded by congealed oil or mechanical defect. | b. Check for cause of overload. |
| 5. Sluggish pitch change in constant speed range. | a. Sludge in governor oil lines. | a. Flush with suitable solvent. |
| | b. Binding transmission. | b. Check gear alignment. |
| | c. Excessive internal leakage. | c. Check hydraulic motor and governor parts for evidence of excessive wear. |
| 6. Overspeeding or underspeeding on take-off. | a. Improper setting on high rpm adjusting screw. | a. Readjust. |
| | b. Defective governor. | b. Replace. |
| 7. Excessive gear noise. | a. No clearance between hydraulic stop and mechanical low pitch stops. | a. Run up engine, exercise propeller several times and stop in low pitch. Count number of teeth off mechanical stops. Adjust as necessary. |




1. Airspeed Indicator
2. Altimeter
3. Artificial Horizon
4. Directional Gyro
5. Clock
6. Tachometer
7. Volt-Ammeter, Left Generator
8. Manifold Pressure
9. Magnetic Compass
10. Volt-Ammeter, Right Generator
11. Left Engine Gage
12. Free Air Temperature
13. Suction Gage
14. Right Engine Gage
15. Cylinder Head Temperature
16. Radio Control Unit
17. Turn-and-Bank Indicator
18. Stall Warning Light
19. Rate of Climb
20. Ignition Switches
21. Starter Switches
22. Battery Master Switch and Lock
23. Primer Switches

Figure 5-1. Instrument Panel

5.1 INSTRUMENT PANEL -

The floating instrument panel is shock mounted at eight points, three regular shock mounts along the middle of the panel, three rubber bumpers at the top and two at the bottom. The flight instruments are grouped on the left side of panel while the engine instruments are grouped on the right side. The instrument panel, except for the gyro instruments, is tilted forward ten degrees for better legibility. All instruments are front mounted, that is they may be mounted and removed from the front except the two gyros. The subpanel and control console, just below the floating panel, mount the operational switches, warning lights, circuit breakers and engine controls. There are several openings in the floating instrument panel for possible future instrument installations.

5.2 FLIGHT INSTRUMENTS -

The flight instruments are located on the left side of the instrument panel in front of the pilot. Suction for gyro instruments is furnished by an engine-driven vacuum pump on each engine. A suction gage, vacuum selector valve, and a centralized air filter are provided in the system. The airspeed indicator is operated on ram air from the pitot and static air from the static ports while the rate of climb and altimeter operate on static air alone. The turn and bank is an electrically operated instrument. The flight instruments are as follows:

(a) Airspeed Indicator
(b) Altimeter
(c) Rate of Climb
(d) Artificial Horizon
(e) Turn and Bank
(f) Directional Gyro

Instruments also used as flight and navigation aids are the clock, magnetic compass, and outside air temperature. The clock is located on the right side of the instrument panel, while the compass and the free air temperature gage are installed in the center of the windshield above the instrument panel.

The pitot system consists of the pitot head, pitot heater and related plumbing and electrical systems. Impact pressure entering the pitot head is transmitted via plumbing to the airspeed indicator. The pitot head is electrically heated to prevent the formation of ice in the pitot opening, with a resultant erroneous reading of the airspeed indicator. The pitot line is equipped with a drain, located behind the removable leading edge of the wing between the fuselage and the left engine nacelle, through which water from rain or condensation may be drained.

The static source consists of two static ports, one on each side of the fuselage just forward of the horizontal stabilizer leading edge. The static line is routed forward along the top center of the inside of fuselage, crosses over to the left side just aft of the rear baggage compartment and is then routed forward along the inside of the left fuselage about midway up the side of the fuselage until it reaches the instrument panel. At this point it turns inboard to attach to the airspeed indicator, altimeter and rate of climb indicator.

NOTE

It is imperative that the static ports be clean and unobstructed for proper function of those instruments dependent on static pressure for operation.

5.3 ENGINE INSTRUMENTS -

The engine instruments, the clock and suction gage are mounted in the floating instrument panel to the right of the control quadrant. The engine instruments are as follows:

(a) Tachometer
(b) Manifold Pressure
(c) Engine Gauge (Oil Temperature, Oil Pressure, and Fuel Pressure)
(d) Cylinder Head Temperature
(e) Volt-Ammeter

The manifold pressure, oil pressure, fuel pressure and suction gauge have either flexible hose or tubing connections on the back of the instrument. The tachometer, oil temperature, cylinder head temperature, clock and the volt-ammeter have electrical connections on the back of the instrument. The engine instruments are all front mounted.

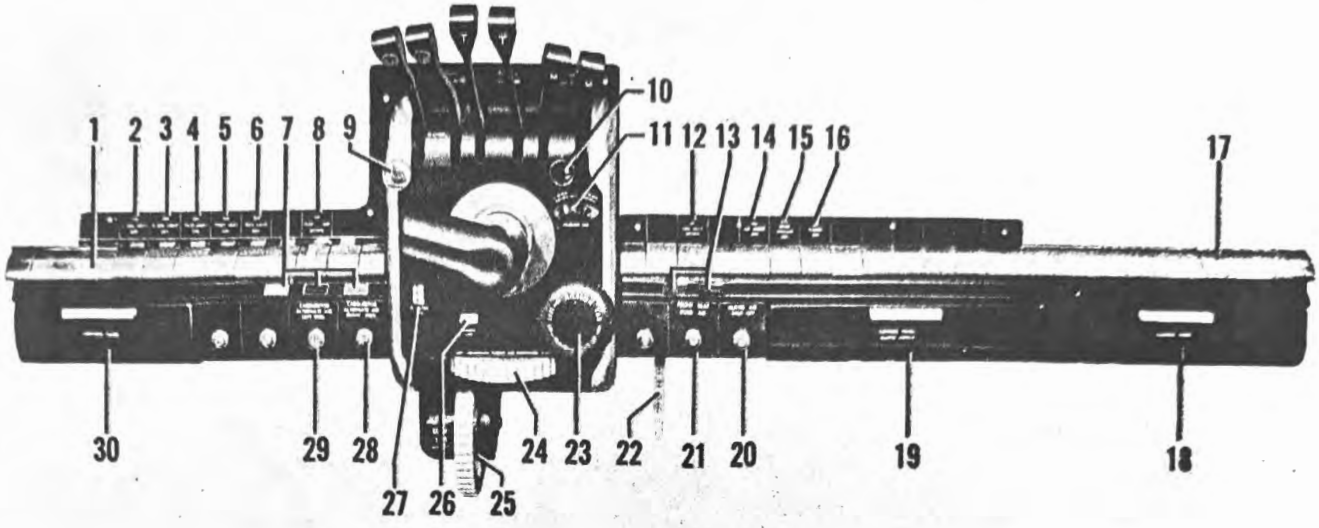
5.4 INSTRUMENT REMOVAL -

To remove an instrument from the floating panel, proceed as follows:

(a) Pry off plastic placard strip over switches and engine controls. The plastic strip is held in place by fasteners that push into locking position. To remove, place a screw driver blade under the strip and pry outward taking care to not break the plastic.
(b) Remove the screws securing the false panel to the aircraft structure, then insert a finger in the hole in the inboard side of the glove compartment and rotate the panel retainer clip aside.
(c) Pull panel out from bottom to clear instrument knobs and pull panel up and out.
(d) Remove the mounting screws from face of the front mounted instruments.
(e) On all instruments except the gyros, pull the instrument out far enough to reach the connections on the back of the instrument.
(f) Disconnect the electrical connections or plumbing. In some cases it may be necessary to disconnect these connections from the rear of the panel.
(g) On the gyros, disconnect the plumbing and wiring from the back of the panel. Remove the mounting screws and remove the instrument from the back of the panel.

5.5 INSTRUMENT INSTALLATION -

(a) Connect the electrical wiring and plumbing to the front mounted instruments.
(b) Insert the instrument in the panel cut-out and install the mounting screws.
(c) Connect any connections that were not possible before installing the instrument. On the gyros it will be necessary to install the instrument from the rear and then make the connections.
(d) Install the false panel by inserting it under the clips and moving it into position over the instrument knobs. Rotate the panel retainer clip back into position, through the hole in the glove compartment.




1. Ash Tray
2. Left Landing Light
3. Right Landing Light
4. Taxi Light (For optional equipment)
5. Pitot Heat
6. Navigation Lights
7. Flap Position Indicators
8. Flap Position Switch
9. Control Friction Lock
10. Cigarette Lighter
11. Aileron Tab Indicator
12. Landing Gear Position Switch
13. Landing Gear Position Indicators
14. Air Conditioner (For optional equipment)
15. Rear Speaker Switch
16. Radio Master Switch
17. Ash Tray
18. Right Control Panel
19. Control Panel, Master Switches
20. Heater Air Control
21. Cold Air Control
22. Parking Brake Handle
23. Aileron Tab Control
24. Rudder Tab Control
25. Elevator Tab Control
26. Rudder Tab Indicator
27. Elevator Tab Indicator
28. Right Carburetor Alternate Air
29. Left Carburetor Alternate Air
30. Left Control Panel

**Figure 5-2. Subpanels and Control Console**

(e) Install the mounting screws that secure the false panel to the aircraft structure.
(f) Install the plastic placard strip over swltches and engine controls. Secure the fasteners by pushing into locking position.

5.6 INSTRUMENT VACUUM SYSTEM -

The vacuum system consists of two engine-driven vacuum pumps (one on each engine), an oil separator in each engine accessory section, a suction relief valve in each wheel well, a filter behind instrument panel, a suction gage on instrument panel, and necessary interconnecting tubing and hose. It powers the gyro-controlled flight instruments.

5.6.1 Adjustment of Suction Relief Valve -
(a) Loosen locknut and turn adjusting screw counterclockwise to increase suction, or clockwise to decrease suction.
(b) Adjust suction relief valve to draw 4.25 inches of mercury at cruising speed.

5.6.2 Removal of Vacuum Pump -
(a) Disconnect suction and discharge lines.
(b) Remove nuts from the four mounting studs.
(c) Pull pump out and off engine mounting pad.

NOTE

Before installation of pump, make sure lubrication holes in pump flange are not covered by the flange gasket.

5.6.3 Installation of Vacuum Pump -
(a) Place gasket in position on mounting studs.
(b) Place pump on engine mounting pad.
(c) Install and tighten nuts.

5.6.4 Removal of Oil Separator -
(a) Disconnect inlet, outlet, and oil return lines.
(b) Remove two bolts from mounting brackets.
(c) Lift unit from mounting.

NOTE

Clean oil separator in unleaded gasoline or other suitable solvent and dry thoroughly with compressed air each 100 hour inspection.

5.6.5 Installation of Oil Separator -
(a) Place unit in mounting bracket.
(b) Install bolts in mounting bracket and tighten.
(c) Connect inlet, outlet, and oil return lines.

5.6.6 Removal of Suction Relief Valve -
Disconnect lines at inlet and outlet elbows. Unit will fall free.

5.6.7 Installation of Suction Relief Valve -
Connect lines at inlet and outlet elbows.

5.6.8 Removal of Filter -
(a) Disconnect instrument lines at manifold.
(b) Remove nuts from the two mounting bolts.
(c) Remove filter bowl to clean or replace filter element.

NOTE

The filter should be cleaned every fifty hours. To clean element blow air through element in the direction opposite normal flow. Care should be taken not to blow air into element at right angles, as this will tend to clog dust in element. Tilt air hose at approximately forty-five degrees. After dust has been blown from element, wash in alcohol, then dry with compressed air.

5.6.9 Installation of Filter -
(a) Place unit on mounting bracket.
(b) Install nuts on the two mounting bolts.
(c) Connect instrument lines at manifold.

CHART 5-1. TROUBLE SHOOTING, VACUUM SYSTEM

| TROUBLE | PROBABLE CAUSE | CORRECTION |
|---|---|---|
| 1. Low suction gage reading. | (a) Suction relief valve not properly adjusted. | (a) Adjust. |
| | (b) Pump failure. | (b) Replace. |
| | (c) Insufficient lubrication of pump. | (c) Remove pump and check lubrication. |
| | (d) Leak or break in suction line. | (d) Locate and repair. |
| | (e) Defective gage. | (e) Replace. |
| | (f) Defective suction relief valve. | (f) Replace. |
| | (g) Oil separator clogged or defective. | (g) Clean or replace. |
| 2. High suction gage reading. | (a) Suction relief valve not properly adjusted. | (a) Adjust. |
| | (b) Defective suction relief valve. | (b) Replace. |
| | (c) Defective gage. | (c) Replace. |
| | (d) Suction relief valve screen clogged. | (d) Clean Screen. |
| 3. Suction gage inoperative. | (a) Clogged lines. | (a) Clean lines. |
| | (b) Shaft on vacuum pump broken. | (b) Replace pump. |
| 4. Vacuum operated instruments sluggish or inoperative but gage showing normal suction. | (a) Clogged filter element. | (a) Clean filter element. |

CHART 5-2. TROUBLE SHOOTING, PITOT AND STATIC SYSTEM

| TROUBLE | PROBABLE CAUSE | CORRECTION |
|---|---|---|
| 1. Heating element inoperative. | (a) Defective switch. | (a) Replace. |
| | (b) Grounded or open circuit. | (b) Check continuity. Repair or replace as necessary. |
| | (c) Defective heater. | (c) Replace pitot head. |
| 2. Circuit breaker keeps tripping. | (a) Grounded wire. | (a) Repair or replace wire. |
| 3. Instruments inoperative or erratic in operation. | (a) Lines clogged. | (a) Drain lines at drain cocks, disconnect at instruments and blow out with low pressure air. |
| | (b) Loose connections. | (b) Check all connections. |

## 6. GENERAL DESCRIPTION

This airplane is equipped with a 24-volt electrical system powered by two 12-volt batteries connected in series and two 24-volt generators connected in parallel.

### 6.1 BATTERY SYSTEM

Energy to start the engines and operate the electrical equipment is furnished by two 12-volt, 33-ampere hour batteries. The batteries are connected in series to the bus system through two relays, one in the negative lead and one in the positive lead for dual safety. The battery master switch is actuated by a key on the instrument panel. A separate toggle switch, wired in series with the key switch and mounted beside the generator switches, permits simultaneous cutoff of all electrical power in an emergency with a gang lever. A mechanical linkage from the master switch key locks the magneto switches so they cannot be turned on when the key is removed from the airplane. All primary circuits are fed through circuit breakers from the bus system. The structure of the airplane is used as the common ground return for all circuits.

6.1.1 Trouble Shooting -
See Chart 6-1, Trouble Shooting, Battery System.

6.1.2 Removal of Battery -
(a) Make certain battery switches are in "OFF" position.
(b) Remove and tape battery terminals to prevent shorting while other battery is still connected to system.
(c) Remove wing retaining nuts and lift battery from airplane.

6.1.3 Installation of Battery -
(a) Make certain battery switches are in the "OFF" position.
(b) Place battery in well with terminals toward the engine.
(c) Center hold-down block, install retaining nuts and safety.
(d) Connect battery terminals.
(e) Fasten nacelle door.

### 6.2 STARTER SYSTEM

Each engine is equipped with an Eclipse direct-cranking starter. The starters are operated through relays from individual push-button switches on the left side of instrument false panel.

6.2.1 Trouble Shooting -
See Chart 6-2, Trouble Shooting, Starters.

NOTE

If both engines fail to start, check to see whether nose baggage compartment door is properly latched. A safety switch built into the door latching mechanism opens the circuit to the starting solenoids if the door is not latched.

6.2.2 Removal of Starter -
(a) Open engine cowling.
(b) Disconnect and tape leads to starters.
(c) Remove starter mounting nuts.
(d) Lift starter aft and up to remove.

6.2.3 Minor Repairs and Parts Replacement, Starter -
Limit field repairs to external cleaning, replacement of cables, brushes and brush springs, and cleaning of the commutator. If other repairs are necessary, send the starter to the nearest BEECHCRAFT Certified Service Station.

CAUTION

Do not use carbon tetrachloride to clean starter parts as it will destroy the lubricating properties of the brushes. Unleaded gasoline is a satisfactory cleaning agent.

6.2.4 Installation of Starter -
(a) Place starter in position and install mounting nuts.
(b) Connect starter cables.
(c) Fasten engine cowling.

### 6.3 GENERATOR SYSTEM

The generator system consists of two 24-volt, 50-ampere generators connected in parallel, with a reverse-current relay and voltage regulator for each generator. A variable equalizing resistor in the paralleling circuit of each voltage regulator permits efficient paralleling of generator loads after minimum-load voltage is adjusted with the regulator rheostats. The system is controlled by two toggle switches in the right subpanel electrical compartment. When the switches are placed in the "OFF" position, the field circuits and equalizing circuits are opened simultaneously. A pair of volt-ammeters mounted on the floating panel indicate generator output. Circuit protection is afforded by two push-to-reset circuit breakers in the generator control box.

6.3.1 Trouble Shooting -
See Chart 6-3, Trouble Shooting, Generators.

6.3.2 Removal of Generator -
(a) Open cowling.
(b) Disconnect cables to generator.
(c) Remove generator retaining nuts.
(d) Slide generator aft and outward to remove.

6.3.3 Minor Repairs and Parts Replacement, Generators -
Limit field repairs to external cleaning, cleaning of the commutator, and replacement of brushes and brush pressure springs.

NOTE

If the generator requires other repairs than those mentioned above, it should be removed and sent to the nearest BEECHCRAFT Certified Service Station.

CAUTION

Do not use carbon tetrachloride to clean parts. Unleaded gasoline or some other similar solvent should be used.

6.3.4 Installation of Generator -
(a) Install new gasket on engine mounting pad.
(b) Turn armature and check for free rotation.
(c) Bolt generator securely in place.
(d) Attach generator leads to generator.
(e) Fasten engine cowling.

6.3.5 Adjustment, Generator System -

6.3.5.1 Generator Field Flashing -
(a) If generator voltage is not indicated on the voltmeter during engine run-up, check the following probable causes:
1 High resistance film of gummed oil on generator commutator.

NOTE

The commutator need not have a bright surface since a slight bronze discoloration is desirable for high generator load and high altitude operation.

2 Loose connections or open circuit.
3 High brush-to-commutator resistance caused by weak brush springs or excessive friction between brushes and brush guides.
4 Excessive resistance in the field circuit caused by a sticking voltage regulator.
(b) If the above causes have been eliminated and the trouble appears to be reversed polarity or loss of residual magnetism, the generator field may be flashed as follows:
1 Turn the generator switch and battery switch to the "ON" position.
2 Remove the voltage regulator from the generator circuit to be flashed.
3 Disconnect wire from terminal marked "SW" on the reverse current relay, in order to prevent possible damage to electrical instruments connected to the system.
4 Connect one end of a suitable length of cable, 18-gage or larger, to the generator "A" terminal on the voltage regulator base.
5 With engine operating at idling rpm, touch the other end of cable to terminal marked "BAT" on the reverse current relay and hold for one second.
6 Reinstall voltage regulator and "SW" wire on reverse current relay.
7 Run engine up to cruising rpm and note whether voltmeter shows a reading.
8 If a voltage is not obtained, the generator is faulty and must be replaced. If a voltage is obtained temporarily but is not maintained, replace voltage regulator.

6.3.5.2 Generator Paralleling -
(a) It is essential that both generators share the electrical load equally in order that one generator will not take so much of the load as to cause it to burn out. Keeping both generators paralleled, therefore, will materially increase generator life and decrease costly maintenance.

Briefly, paralleling of the Model E-50 generators consists of adjusting both voltage regulator rheostats to give equal minimum-load voltages and then adjusting the equalizer resistors so that both generators supply equal amperages when the system is under full load.
(b) In step form, the procedure is as follows:
1 Bring voltage regulators up to normal operating temperature by flying airplane for a minimum of 15 minutes with battery and generator switches and a small load turned on.
2 Upon landing, connect the positive lead of a 0-30 volt precision voltmeter to the common bus terminal post (or common connector between circuit breakers) in the generator control box. Ground the negative lead.

NOTE

The voltmeters on the instrument panel are not suitable for test purposes.

3 Turn off left generator and all possible electrical load, throttling back left engine. Run up right engine to 2200 rpm with right generator "ON" and check voltage.
4 If the meter does not read 28 volts, turn rheostat knob on voltage regulator one notch at a time (clockwise to increase voltage, counterclockwise to decrease it) until a reading of exactly 28 volts is obtained.

CAUTION

Never adjust the core or pile adjusting screws (slotted heads), since the voltage setting as well as the regulating characteristics of the regulator will be altered.

5 Repeat Steps 3 and 4 for the left genera-

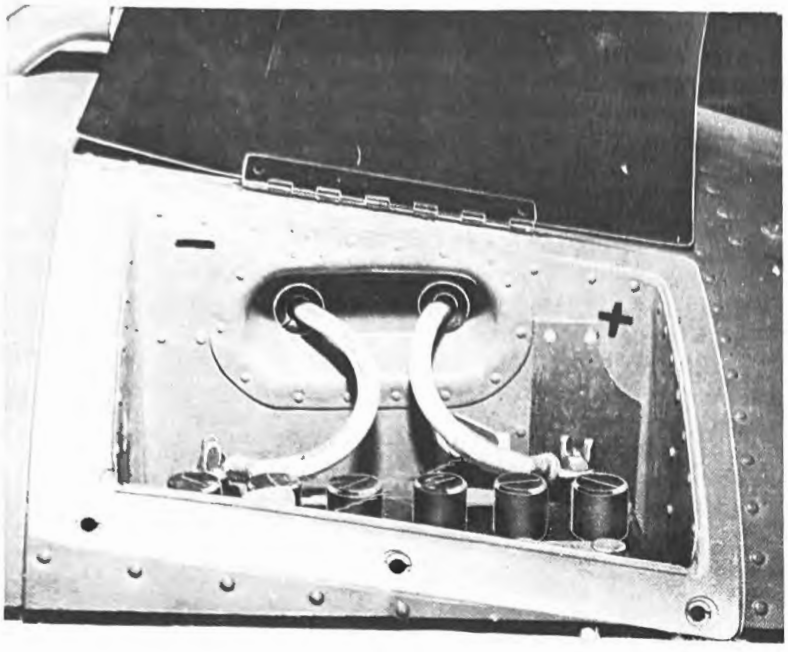


Figure 6-1. Battery Location

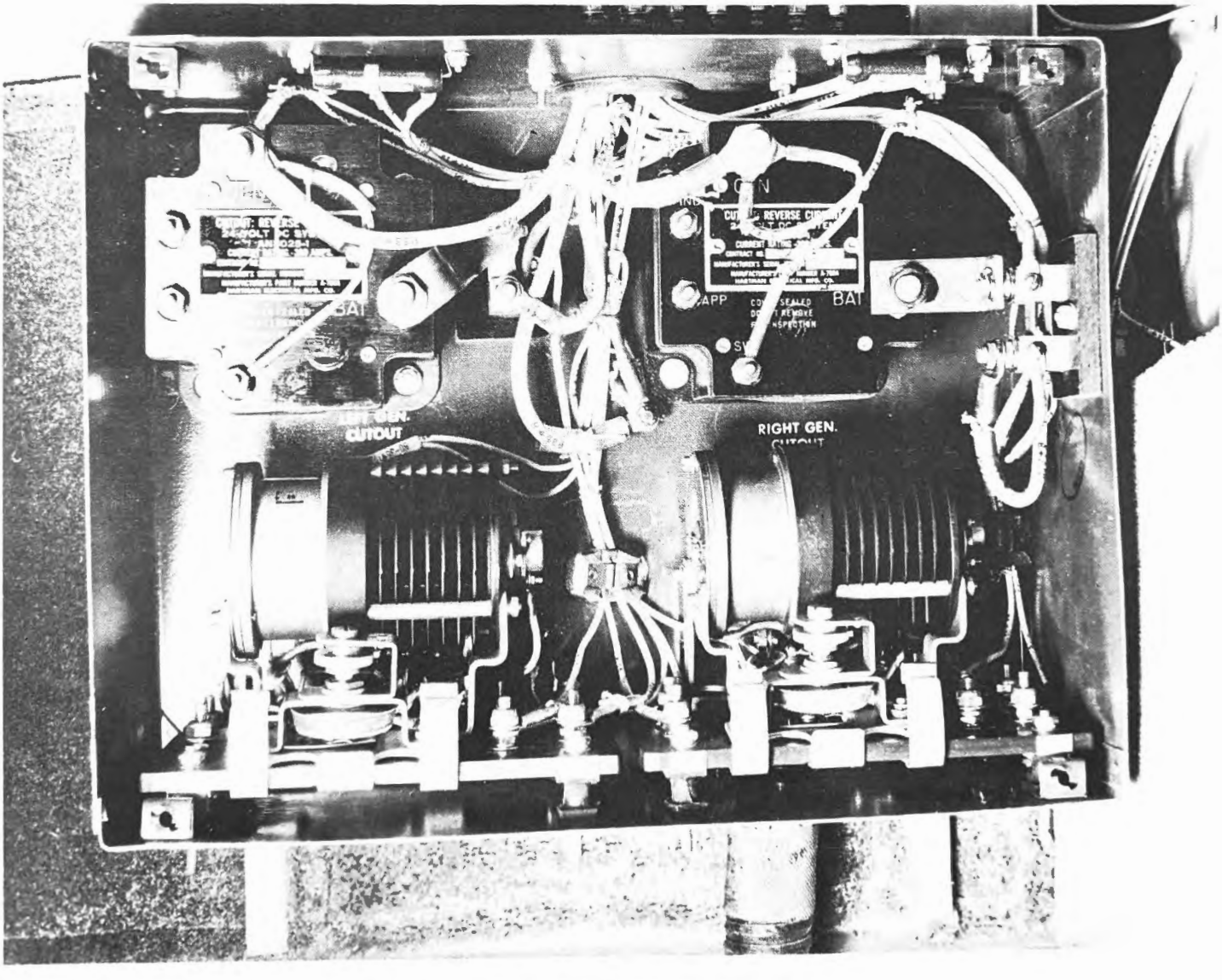



Figure 6-2. Generator Control Box

tor with right generator "OFF".

6 With both engines at 2600 rpm, switch from one generator to the other several times and make any fine adjustments necessary to maintain minimum load voltage at 28 volts.

7 Check ammeters on instrument panel for accuracy by switching on the normal operating (cruising) electrical load. If equal readings are obtained as each generator supplies the current individually, ammeters are satisfactory.

8 With both generators "ON", turn on all possible electrical load. Each generator should take its share of the load within plus or minus 5 amperes.

9 As necessary, adjust the equalizer resistors in the generator control box until the load is equally shared. (To make a generator take more load, move the equalizer tap toward the ground end of the equalizer resistor and to make it take less, move tap away from the ground end.)

CAUTION

Avoid overheating engines during ground run-up.

10 Remove precision voltmeter.

6.3.6 Testing, Generator System -

6.3.6.1 Reverse Current Relay - (AN3025-1)

(a) The reverse current relay will close when generator voltage is between 20 and 24-volts, provided this voltage exceeds bus voltage by .35 to .65 volt, and the generator switch is "ON". The relay automatically disconnects the generator from the bus when from 16 to 25 amperes of reverse current are flowing from battery to generator.

(b) While the relay is not adjustable in the airplane, proper relay operation may be checked as follows:

1 Using a precision voltmeter, ground the negative lead and attach the positive lead to the "BAT" terminal of the relay.

2 Start engine and run at idling speed, noting indication on the test voltmeter.

3 Advance throttle SLOWLY until meter shows a sudden increase in voltage, indicating point at which relay closes. If relay does not close between 20 and 24-volts, it must be replaced.

NOTE

The reverse current relay is entirely self-contained and automatic, therefore requiring no adjustment. Since this is a delicate device, the cover should not be removed for any reason except overhaul by qualified personnel with suitable bench test equipment.

6.4 INTERIOR LIGHTING

6.4.1 Pilot's Compartment Lights -

Instrument lights are both red and ultra-violet. Intensity of both lights can be varied by a rotary switch in the light panel over the pilot's head. A clear map-reading light is also provided in the overhead light panel. The fuel-quantity indicator and tab-position indicator are illuminated by separate lights which are controlled by a rotary switch in the overhead light panel. Cabin lights on each side of the rear ceiling are lighted automatically when the cabin door is opened and the battery switch is on. A manual switch for the cabin lights is mounted on the left overhead panel.

6.4.2 Baggage Lights -

The front and rear baggage compartments are equipped with dome lights controlled by automatic switches on the doors.

6.4.3 Trouble Shooting -

See Chart 6-4, Trouble Shooting, Cabin Lights.

6.4.4 Replacement of Fixtures -

(a) Remove fixture cover and mounting screws, lift assembly from mount, and disconnect electrical leads.

(b) Connect electrical leads, place fixture in position, install, and tighten cover.

6.5 NAVIGATION LIGHTS

The navigation lights consist of a red light on the left wing, a green light on the right wing and a white light on the tail which operate through a Narco flasher unit. The flasher is designed to give steady light if malfunction occurs. The navigation lights are controlled by a switch on the pilot's panel to the left of the control column.

6.5.1 Replacement of Flasher Unit -

(a) The flasher unit is located to the left of the control column and forward of the instrument panel.

(b) To remove the flasher, disconnect the two leads and remove the bolts holding it to the structure.

(c) Mount the new flasher, tightening bolts and leads.

(d) Make operational check.

6.6 LANDING LIGHTS

The landing lights are mounted in the leading edges of both wings, recessed behind transparent plastic covers. The lamps are Sealed Beam units, Type 4523. They are controlled separately by switches on the instrument subpanel.

6.6.1 Trouble Shooting -

See Chart 6-5, Trouble Shooting, Landing Lights.

6.6.2 Removal of Landing Light -

(a) Remove screws securing plastic cover and remove cover.

(b) Remove four screws from retainer ring, remove ring and pull lamp forward.

(c) Remove wires from screw terminals on lamp base.

6.6.3 Minor Repairs -

The lamp is a sealed unit incorporating lens, reflector and filament. If lamp is defective it must be replaced.

6.6.4 Installation of Landing Light -

(a) Connect electrical leads.

(b) Place lamp in position and install retainer ring and plastic cover.

(c) Operate light to test for proper installation.

## 6.7 STALL-WARNING CIRCUIT

The stall warning system is designed to afford the pilot both visual and aural indication of an impending stall. It consists of a light on the instrument panel and a warning horn mounted behind the panel, both connected to a sensing unit on the leading edge of the left outboard wing panel. The sensing unit consists of a Micro switch, actuated by a small detector vane when the airflow across the leading edge of the wing approaches a stalling condition. The airspeed at which a stall warning will occur will vary, as does the stalling speed itself, with various flight conditions. The sensing unit is set to close the circuit 7 to 9 mph above stalling speed with gear and flaps up and power off. The stall warning horn sounds a constant note, to be easily distinguishable from the intermittent note of the landing-gear warning horn.

6.7.1 Trouble Shooting -

See Chart 6-6, Trouble Shooting, Stall-Warning Circuit.

6.7.2 Adjustment -

Whenever the sensing switch is replaced, or repairs or adjustments are made to the wings, the airplane must be test-flown to check adjustment of the stall warning system. With gear and flaps up and power off, the airplane is to be stalled gently, straight ahead, reducing speed not more than one mph per second. The stall warning indicator should function at 7 to 9 mph above complete stall. If readjustment is required, loosen the two screws beside the detector vane opening in the mounting plate. Move the switch up and forward to raise the indication speed, or down and back to lower the indication speed. A movement of 1/4 inch will shift the indication speed about 5 mph. After each adjustment, the airplane must be test-flown to check the setting.

CAUTION

The detector vane is heat-treated. Never attempt to adjust the switch by bending the vane. Never coat the vane with dope, paint or other material; such coating will interfere with correct operation.

## 6.8 DYNAMIC BRAKE RELAY

The dynamic brake relay is mounted beneath the right front seat near the landing-gear motor. It forms the link between the motor and the landing-gear control circuit. The relay has two solenoid-operated, double contactors, spring-loaded normally open to the motor power supply. The solenoids are actuated by the landing-gear control circuit. When the landing-gear position switch is closed, either "UP" or "DOWN", it energizes the solenoid of the contactor selected, which closes the power contacts, establishing the running circuit to the motor.

When the control circuit is opened, either by the landing-gear position switch or the limit switch, the solenoid is released. The contactor returns to its normal position, establishing the dynamic braking circuit through the normally-closed contacts of both contactors and a rocker-arm switch which, when the running contact is made, selects for braking the motor field opposite the one used for running.

6.8.1 Testing Dynamic Brake Relay, "UP" -

(a) Jack airplane and support tail section.

(b) Disconnect leads at motor and turn on electrical system. (Tape leads to prevent grounding).

(c) Test continuity from main power terminal of aircraft to Terminal 3 of the dynamic-brake relay.

(d) Manually set the landing gear so that both limit switches are clear and place the landing-gear switch in the "UP" position.

(e) Test from Terminal 1 of the relay assembly to ground with 24-volt test lamp; if the "UP" relay is making proper contact, test lamp will light.

(f) Turning landing-gear switch to "DOWN" or operating the "UP" limit or the safety switch should cause the test light to go off.

6.8.2 To Test "DOWN" Relay -

(a) Repeat the same test for the "DOWN" relay by placing the landing-gear switch in the "DOWN" position and testing from Terminal 2 of the relay assembly to ground. Changing landing-gear switch position or actuating the down-limit switch on the landing gear should cause the light to go out.

CHART 6 1. TROUBLE SHOOTING, BATTERY SYSTEM

| TROUBLE | PROBABLE CAUSE | CORRECTION |
|---|---|---|
| 1. No power indicated with battery master switch key "ON". | a. Batteries discharged or defective. | a. Test with hydrometer. |
| | b. Toggle switch on subpanel "OFF". | b. Turn on. |
| | c. Open circuit between battery and master switch. | c. Check continuity. |
| | d. Master switch defective. | d. Check both switches for operation. Replace if necessary. |
| | e. Defective relay. | e. Check both relays for operation. Replace if necessary. |
| 2. Power on with master in "OFF" position. | a. Master switch defective. | a. Check both switches for operation. Replace if necessary. |
| | b. Relay contacts stuck. | b. Replace relays. |

CHART 6-2. TROUBLE SHOOTING, STARTERS

| TROUBLE | PROBABLE CAUSE | CORRECTION |
|---|---|---|
| 1. Both starters inoperative. | a. Nose baggage door open. | a. Close door. |
| | b. Circuit breaker tripped in starter-switch circuit. | b. Reset. |
| | c. Battery relay inoperative. | c. Check continuity of battery system. |
| | d. Low batteries. | d. Test batteries. If low, replace or start with external power. |
| | e. Loose connection or open circuit between battery positive relay and left starter relay. | e. Check connections and continuity. |
| 2. One starter inoperative. | a. Starter relay inoperative. | a. Check relay terminal connections and continuity of solenoid energizing circuit. If energizing circuit is closed and relay does not operate, replace relay. |
| | b. Poor ground at starter. | b. Test continuity from armature lead to ground. Repair if necessary. |
| | c. Open circuit. | c. Check continuity to starter. |
| | d. Defective starting motor. | d. Check brushes, springs, condition of commutator; replace if necessary. |

CHART 6-3. TROUBLE SHOOTING, GENERATOR

| TROUBLE | PROBABLE CAUSE | CORRECTION |
|---|---|---|
| 1. Zero or low voltage indicated. | a. Engine speed too low. | a. Increase speed. |
| | b. Loose connection. | b. Check connections throughout system. |
| | c. Open or shorted field circuit in generator; defective armature. | c. Test resistance of field. Check field circuit connections. Replace generator if defective. |
| | d. Brushes not contacting commutator. | d. Clean brushes and holders with a clean, lint-free, dry cloth. Replace weak springs. |
| | e. Brushes worn out. | e. Replace brushes if worn to a length of 1/2 inch or less. |
| | f. Dirty commutator. | f. With generator running, clean commutator with No. 0000 sandpaper. Use air jet to remove grit. |
| | g. Defective voltage regulator. | g. Replace regulator. |
| | h. Defective voltmeter. | h. Replace voltmeter. |
| 2. No generator output. | a. Circuit breaker tripped. | a. Reset. |
| | b. Open circuit. | b. Check continuity of circuit. |
| | c. Loss of residual magnetism. | c. Flash generator field. |
| | d. Defective generator control switch or reverse current relay. | d. Test switches. Replace if defective. |
| | e. Generator not turning. | e. Check generator shaft. Replace generator if necessary. |
| 3. Low generator output. | a. Generators not paralleled. | a. Readjust minimum-load voltage. Then readjust equalizer resistors. |
| 4. Ammeter or voltmeter reads off scale in wrong direction. | a. Generator field magnetized in wrong direction. | a. Flash field. |
| 5. Ammeter or voltmeter fluctuates excessively. | a. Loose connection on "SW" terminal of reverse current relay. | a. Tighten. |
| | b. Loose connection or ground in aircraft wiring. | b. Check entire system. |

CHART 6-4. TROUBLE SHOOTING, CABIN LIGHTS

| TROUBLE | PROBABLE CAUSE | CORRECTION |
|---|---|---|
| 1. Lights inoperative. | a. Circuit breaker tripped. | a. Check for short circuit. Reset circuit breaker. |
| | b. Loose connection. | b. Check and tighten electrical connections. |
| | c. Batteries defective. | c. Replace batteries or use external power. |
| 2. One bulb does not light. | a. Bulb burned out. | a. Replace bulb. |
| | b. Fixture not grounded. | b. Check for good bonding between fixture and structure. Tighten mounting screws. |
| | c. Loose connection. | c. Check all connections in circuit. |
| | d. Defective fixture or switch. | d. Replace fixture or switch. |

CHART 6-5, TROUBLE SHOOTING, LANDING LIGHTS

| TROUBLE | PROBABLE CAUSE | CORRECTION |
|---|---|---|
| 1. Lamp fails to light. | a. Circuit breaker tripped. | a. Check for short circuit. Reset circuit breaker. |
| | b. Lamp burned out. | b. Replace lamp. |
| | c. Loose connection or defective wire. | c. Tighten connections and check circuit continuity. Replace or repair wire if necessary. |
| | d. Landing-light switch defective. | d. Check continuity through switch. Replace if necessary. |

CHART 6-6. TROUBLE SHOOTING, STALL-WARNING CIRCUIT

| TROUBLE | PROBABLE CAUSE | CORRECTION |
|---|---|---|
| 1. Warning horn inoperative. | a. Horn circuit breaker tripped. | a. Reset. |
| | b. Open Circuit. | b. Check continuity:<br>(1) Circuit breaker to indicator.<br>(2) Indicator to switch.<br>(3) Switch to ground. |
| | c. Defective switch. | c. Check switch operation. |
| | d. Defective indicator. | d. Check horn operation. |
| 2. Horn stays on. | a. Grounded circuit between horn and switch. | a. Test for ground. |
| | b. Defective switch. | b. Check switch operation. |

# PART VII
# ELECTRONIC SYSTEM

## 7.1 GENERAL DESCRIPTION

The B-50 radio equipment consists of a T-11B transmitter and a R-15 receiver for the basic transmitting and receiving operation. To complete the radio equipment the following is included: a R-11A range receiver, a VHF antenna (mast), range antenna (clothes line), junction box, microphone, head-set, two speakers and the control panel. Also included, to accomodate possible future radio installation by the distributor, is an antenna lead-in for an omni installation and an extra shelf under the receivers and transmitter.

CAUTION

Maintenance of internal circuits of this equipment should be accomplished by BEECHCRAFT Certified Service Stations. Much of this equipment is bench tuned (pretuned) and calibrated. Tampering, in some instances even changing a tube, may change the alignment of a unit and make it inoperative.

A AS-33 headset and a microphone are provided for the reception and transmission of radio communication. The headset and mike are suspended, each from a hook, to the left of the pilot. Receptacles are located below and aft of the headset-mike location.

The radio junction box is located in the top of the forward baggage compartment above the heater. The junction box serves as a connecting point for the various circuits of the radio installation.

Two speakers are installed in the cabin for possible future use with additional radio equipment. The front speaker, mounted over the front seat is an Operadio Manufacturing Company S10340 speaker. The rear speaker, mounted behind the rear seat in the forward wall of the baggage compartment, is a Jensen Manufacturing Company P8-T speaker. The volume for the speakers is controlled by the sensitivity switches on the radio control unit. An "ON-OFF" switch for the rear speaker is located on the right sub panel. The speakers are connected electrically to the junction box for connection of added equipment.

## 7.2 CONTROL UNIT

The radio control unit is located on the right side of the instrument panel and accomodates the remote controls for the radio equipment. Individual tuning cranks, sensitivity control knobs and frequency indicating dials are provided for the receivers with a frequency selector switch provided for the transmitters. Control wires from the sensitivity knobs and flexible drives from each of the tuning cranks are routed to the receivers. The control wires from the frequency selector switch are connected to the transmitter relays and the frequency channels, selected by the switch, are indicated on the front panel of the control unit by removable tabs. The frequency channels may be changed to fit the needs of a particular locality by changing the crystals.

7.2.1 Removal of Control Unit -
(a) Turn each receiver tuning dial to its timing mark to insure proper synchronization of controls and receivers upon reinstallation.

NOTE

The timing marks are located on the high frequency end of the tuning dials.

(b) Remove the mounting screws and pull the control unit from the instrument panel.
(c) Disconnect the flexible drives.
(d) Disconnect the electrical plugs and remove the control unit.

7.2.2. Installation of Control Unit -
(a) Set the tuning dials on their timing marks, connect and safety wire the flexible drives.
(b) Connect and safety wire the electrical plugs.
(c) Position the control unit on the instrument panel and secure with the mounting screws.

## 7.3 RANGE RECEIVER

The R-11A range receiver, located on the left side of the forward baggage compartment on the rear of the mounting shelf, is a six-tube superheterodyne receiver and operates on high voltages produced by a D-10A dynamotor mounted on the receiver chassis. This receiver is designed for the reception of low-frequency radio range stations and for homing or direction finding. It can be tuned continuously over a frequency range of 190-550 kilocycles by means of a flexible drive connected to the tuning cranks on the control unit.

7.3.1 Removal of the Range Receiver -
(a) Remove the radio rack cover plate.
(b) Disconnect electrical coupling from its receptacle.
(c) Disconnect the range antenna wire from the antenna receptacle.
(d) Disconnect flexible drive from the tuner.

NOTE

Before removing the flexible drives, turn each receiver tuning dial to its timing mark to insure proper synchronization of controls and receivers upon reinstallation.

(e) Remove the safety wire, and release the slide

fasteners from the locking lug.
(f) Lift the receiver from its mount.

7.3.2 Installation of the Range Receiver -
(a) Place the receiver on its mounting.
(b) Lock the slide fasteners on the locking lugs.
(c) Safety the slide fasteners.
(d) Connect the flexible drive to the tuner.

NOTE

If a new receiver is being installed it must be synchronized with the tuning dial by turning the flexible shaft to the end of counterclockwise travel and make a check to see that the tuning dial is still set on the timing mark.

(e) Connect electrical coupling to its receptacle.
(f) Connect the range antenna to the antenna receptacle.

7.3.3 Testing the Range Receiver -
Place the airplane battery switch in the "ON" position and operate the radio equipment as described in paragraph 7.10. Feel the D-10A dynamotor on the range receiver to check that it is running and see that all microphone and head-set plugs are properly inserted in their respective jacks. Check the control unit for proper frequency indication and if it is inaccurate, adjust the tuning dial in the following manner:
(a) Turn the tuning crank as far as it will go in a counterclockwise direction.

NOTE

Do not force the tuning crank when the stop is reached; to do so may result in damage to the receiver.

(b) Note that the small dot about 1/8 inch above the top frequency indication is directly under the reference mark.
(c) If full counterclockwise rotation of the tuning control does not result in the dot being under the reference mark, remove the flexible linkage at the receiver and turn the tuning crank until the dot is under the mark. Replace the linkage at the receiver, being careful not to disturb the relationship of shaft and spline.
(d) Test the accuracy of dial positioning by tuning in several stations of known frequency.
The receiver input circuits may be checked in the following manner:
(e) Check to see that the antenna and strap connections to the VHF receiver are connected to the "L" post on the R-11A receiver.
(f) Turn the range receiver to the high position of the dial at a point where no signal is received.
(g) Turn the range receiver sensitivity control knob to maximum sensitivity.
(h) Adjust the "ALIGN INPUT" control on the front of the receiver for maximum background noise (greatest sensitivity). It is essential that this operation be performed at the high frequency end of the dial.

NOTE

If the input control is adjusted at the low frequency end of the dial, the adjustment will be so broad that it is likely to be inaccurate at the high frequency end.

(i) Tune in several stations over the band to get a check on the sensitivity.

## 7.4 DYNAMOTOR

Two Type D-10A, completely enclosed and sealed dynamotors, are used to furnish high voltage to the receiving equipment. The dynamotors have a rated input of 3.4 amperes at 14 volts dc and 1.7 amperes at 28 volts dc and their rated output is 0.085 ampere at 250 volts dc. A dynamotor is mounted on both receivers. Each dynamotor is attached, by means of slide fasteners, to a shock mount which is an integral part of the receiver chassis and the electrical connections are made through a built-in connector on the dynamotor which mates with a connector on the receiver chassis.

## 7.5 VHF RECEIVER

The R-15 (VHF) receiver is a nine-tube superterodyne, continuously tunable over the frequency range of 108-135 megacycles by means of a flexible drive connected to the tuning cranks on the control unit. It is located on the left side of the forward baggage compartment on the forward portion of the mounting shelf. This receiver is designed for the reception of voice amplitude-modulated signals and operates on high voltage produced by a D-10A dynamotor mounted on the receiver chassis. The R-15 receiver is used in conjunction with the T-11B transmitter for VHF transmission and reception with control towers.

7.5.1 Removal of the VHF Receiver -
(a) Remove the radio rack cover plate.
(b) Disconnect electrical coupling from its receptacle.
(c) Disconnect the VHF antenna wire from the antenna receptacle.
(d) Disconnect flexible drive from the tuner.

NOTE

Before removing the flexible drives, turn each receiver tuning dial to its timing mark to insure proper synchronization of controls and receivers upon reinstallation.

(e) Remove the safety wire, and release the slide fasteners from the locking lug.
(f) Lift the receiver from its mount.

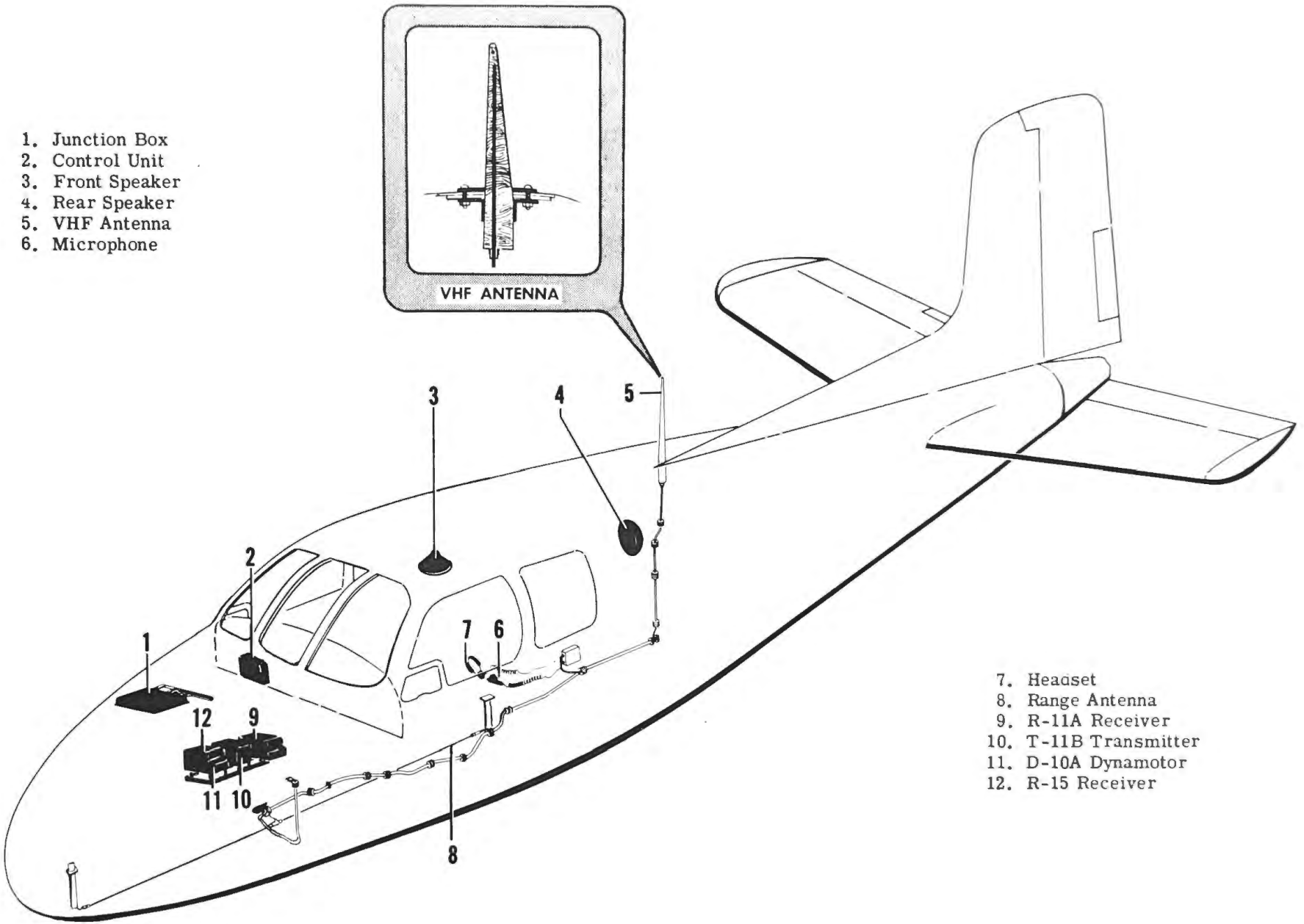



Figure 7-1. Radio Equipment Diagram

7.5.2 Installation of the VHF Receiver -
(a) Place the receiver on its mounting.
(b) Lock the slide fasteners on the locking lugs.
(c) Safety the slide fasteners.
(d) Connect the flexible drive to the tuner.

NOTE

If a new receiver is being installed it must be synchronized with the tuning dial by turning the flexible shaft to the end of counter-clockwise travel and make a check to see that the tuning dial is still set on the timing mark.

(e) Connect electrical coupling to its receptacle.
(f) Connect the VHF antenna to the antenna receptacle.

7.5.3 Testing the VHF Receiver -
Test the VHF receiver in the same manner followed in testing the range receiver, paragraph 7.3.3, steps a through d.

## 7.6 VHF TRANSMITTER

The T-11B transmitter is located on the left side of the forward baggage compartment between the two receivers. This is a four-tube, five-channel, crystal-controlled transmitter. It is capable of transmitting voice signals in any two megacycle bands between 116 and 132 megacycles. Because of the narrow band only one set of tuned circuits is required for the five crystal-controlled frequencies. The frequency on which transmission can be made is governed by the crystals installed in the transmitter; therefore the desired transmission frequency channels may be changed to fit the needs of a particular locality by changing the crystals. This transmitter operates on high voltage received from the D-10A dynamotor located on the R-15 receiver chassis.

7.6.1 Removal of VHF Transmitter -
(a) Remove radio rack cover plate.
(b) Disconnect electrical coupling from its receptacle.
(c) Disconnect the VHF antenna from the antenna receptacle.
(d) Remove the safety wire and release the slide fasteners from the locking lugs.
(e) Lift the transmitter from its mount.

7.6.2 Installation of VHF Transmitter -
(a) Place the transmitter on its mounting.
(b) Lock the slide fasteners on the locking lugs.
(c) Safety the slide fasteners.
(d) Connect the electrical coupling to its receptacle.
(e) Connect the VHF antenna wire to its receptacle.
(f) Check the operation of the transmitter as directed in paragraph 7.10.

7.6.3 Testing the VHF Transmitter -
Place the airplane battery switch in the "ON" position and operate the radio equipment as described in paragraph 7.10. Feel the D-10A dynamotor on the R-15 receiver to check that it is running and check to see that all microphone and headset plugs are properly inserted in their respective jacks. Use the following procedure to check the transmitter tuning:
(a) Turn on the R-15 "OFF-ON" sensitivity control.
(b) Set "TRANS" switch to the frequency position of transmitter to be checked.
(c) Remove the tube cover and connect the plus lead of an 0-3, 1000-ohms-per-volt dc voltmeter to the pin jack in the right front of the chassis. The negative lead should be firmly grounded to the transmitter chassis.
(d) Depress the microphone switch button.
(e) Turn the adjusting screw, at the lower left corner on the left front end of the chassis, for a maximum voltmeter reading.
(f) Turn the center and upper adjusting screws on the left front end of the chassis, for a maximum voltmeter reading; the order in which this is done is immaterial.

NOTE

When turning the three adjusting screws, note that the peak voltage reading will be obtained over several degrees of rotation of the screws. Final adjustment of the screws should be in the approximate center of this "flat top".

(g) Speak into the microphone and note a rise of from 10 to 20 volts in the voltmeter reading as a check on the microphone and modulation circuits.
(h) Turn the "TRANS" selector switch to each frequency position in the transmitter and note that the voltmeter reading remains substantially the same.
(i) An excessive or off-scale voltmeter reading may indicate an open circuit in the antenna cable connecting the transmitter to the antenna. Should such a reading be obtained, check the antenna cables before proceeding with the check and adjustment.

## 7.7 RANGE ANTENNA

The range receiver antenna is a fixed wire-type designed for low frequency reception. It is mounted on the lower right hand side of the fuselage and is suspended between two metal masts. A lead-in wire is connected between the antenna and an insulator on the lower side of the fuselage. There is no maintenance required on the antenna, however, at periodic inspection, check the antenna wire for corrosion or fatigue, and the lead-in wire for worn or damaged insulation. Replace cracked insulators or damaged wiring.

## 7.8 VHF ANTENNA

An AN104B antenna (Figure 7-1) is mounted on

the top side of the fuselage approximately midway between the canopy and the vertical stabilizer. This antenna mast consists of a hardwood oval-shaped rib approximately 31 inches overall in length. The antenna element and transmission line are housed in a drilled cavity that extends up through the center. A socket at the base of the mast is used for making connection to the radio equipment. The upper portion of the mast is covered by a metal sheath which extends to within 8 1/4 inches of the base of the mast. The antenna is supported by two phenolic blocks near the base and by two aluminum plates, one inside the fuselage and one outside, with a rubber gasket between the outside plate and the fuselage. The mast is grounded to the airplane by means of flexible copper braids which attach to the support plate inside the fuselage.

7.8.1 Removal of the VHF Antenna -
(a) Gain access to the base of the antenna mast through the panel in the rear baggage compartment. Disconnect the socket at the base of the mast.
(b) Remove the screws holding the phenolic supports in place and remove the phenolic supports.
(c) Remove the screws that attach the grounding braids to the plate inside the fuselage.
(d) Pull the antenna mast down and out, in some cases it may be necessary to remove the plates and rubber gasket to remove the antenna.

7.8.2 Installation of the VHF Antenna-
(a) Place the antenna in its mounting position. Install the aluminum support plates and rubber gasket if they were removed.
(b) Attach the copper bonding braids to the inside aluminum support plate.
(c) Install the phenolic support plates and secure with the screws.
(d) Connect the socket to the base of the mast.

## 7.9 MECHANICAL LINKAGE

A flexible drive is routed from the tuning attachments of each receiver to the control unit in the cabin. The flexible drives are rotated by manual tuning cranks on the face of the control unit.

7.9.1 Removal of Mechanical Linkage -
(a) Turn each receiver tuning dial to its timing mark to insure proper synchronization of controls and receivers upon reinstallation.

NOTE

The timing marks are located on the high frequency end of the tuning dials.

(b) Disconnect the housing retaining nuts and remove the flexible drive from the control unit.
(c) Disconnect the housing retaining nuts and remove the flexible drive from the receiver tuning attachment and remove the flexible drive.

7.9.2 Mechanical Linkage Repair -
If the linkage tends to bind, a small amount of powdered graphite may be injected into the housing for freedom of operation. Check the housing assembly for sharp bends or kinks. Replace the housing and flexible drive assembly if it is damaged.

7.9.3 Installation of Mechanical Linkage -
(a) Turn each receiver tuning dial to its timing mark to insure proper synchronization of controls.
(b) Position the flexible drives between the control unit and receivers.
(c) Align the drive keys at each end with the slots in the control unit and in the receiver tuning attachments and secure the housing retaining nuts.
(d) Operate the tuning cranks on the control unit and check the synchronization between the control unit and the receiver tuning position in the following manner:
1 Turn on the radio equipment as described in paragraph 7.10.
2 Turn the tuning dial to a station of known frequency. If the station is not received clearly, turn the dial until it is received clearly, then disconnect the mechanical linkage from the tuning cranks and set the dial to the station frequency.
3 Reinstall the mechanical linkage to the tuning cranks and check the dial for proper indication.
4 Repeat the above procedure until the receiver and tuning dials are synchronized.

## 7.10 TESTING THE B-50 RADIO SET

With the airplane battery master switch on "BATTERY", and the "SENS" controls of the R-11A and R-15 receivers turned "ON" feel the dynamotors to see that they are running. Place the battery master switch and the "SENS" controls in the "OFF" position. Check to see that all control unit tuning cranks and the "TRANS" selector switch turn easily and without binding or slipping at any point. Check to see that all microphone and headset plugs are inserted in proper jacks. Check operation of the radio set as follows:
(a) Make sure all switches are in the "OFF" position.
(b) Turn the battery master switch to "BATTERY".
(c) Turn the radio switch to the "ON" position.
(d) Put on the earphones.
(e) Turn the sensitivity range control knob "ON" by rotating clockwise.
(f) Allow warm-up of the unit.
(g) Turn "SENS" switch "ON" and "OFF" several times and listen for low audible tone of dynamotor.

NOTE

The cut-in tone of the dynamotor will be a loud tone, receding to a low audible tone within a few seconds.

(h) Turn the range tuning crank through the complete range of travel, noting reception of the receiver.

If the receiver is operating properly return dial to local tower frequency.

(i) Turn sensitivity tone low but not "OFF".

(j) Repeat the above procedure for the VHF receiver.

(k) Turn the range receiver and VHF receiver, either or both, to a moderate tone.

(l) Turn the transmitter selector switch to a local tower frequency.

(m) Make a radio check with the tower on the microphone by depressing the knob located under the mouth piece and speaking slowly and distinctly into the microphone. If radio operation is normal, place microphone and earphones back in their proper position. Turn the "SENS" control knobs "OFF" (counterclockwise). Turn battery master switch "OFF".

CHART 7-1, TROUBLE SHOOTING B-50 RADIO EQUIPMENT

| | TROUBLE | PROBABLE CAUSE | CORRECTION |
|---|---|---|---|
| 1. | No audible signal. | a. No power to receiver; airplane battery switch in "OFF" position. | a. Place battery switch in "ON" position. |
| | | b. Sensitivity control in "OFF" position. | b. Turn control to "ON" position. |
| | | c. Headset not connected. | c. Plug in headset. |
| | | d. Power cable loose or not connected. | d. Connect or tighten cable. |
| | | e. Defective receiver. | e. See chart 7-2. |
| 2. | Faint or fading signal. | a. Gain not advanced sufficiently. | a. Turn sensitivity control full clockwise. |
| | | b. Receiver not tuned accurately. | b. Retune receiver. |
| | | c. Loose cable connections. | c. Tighten cable connections. |
| | | d. Low voltage. | d. Replace or recharge battery. |
| | | e. Defective tube. | e. Refer to chart 7-2. |
| | | f. Distant station. | f. Tune to nearer station. |
| | | g. Antenna not connected. | g. Check antenna connections. |
| | | h. Antenna input improperly adjusted. | h. Adjust "ALIGN INPUT" control. |
| | | i. Defective dynamotor; improper high voltage. | i. Replace dynamotor. |
| | | j. Defective receiver. | j. Refer to chart 7-2. |
| 3. | Distorted signal. | a. Outside electrical disturbance. | a. Tune to other station or use R-15 only, shutting down R-11A. |
| | | b. Improper antenna connection. | b. Check and reconnect antenna. |
| | | c. Receiver not tuned accurately. | c. Retune receiver. |
| 4. | No audible side tone. | a. "VHF" "OFF" control not on, R-15 Dynamotor not operating. | a. Turn control full clockwise. |
| | | b. Defective dynamotor. | b. Replace dynamotor. |
| | | c. Defective modulator tube. | c. Replace V-204 of T-11B. |
| | | d. Defective transmitter. | d. Refer to chart 7-3. |
| 5. | Faint or fading side tone. | a. Low voltage. | a. Recharge or replace battery. |
| | | b. Dynamotor defective. | b. Replace dynamotor. |
| | | c. Loose cable connections. | c. Tighten cable connections. |
| | | d. Defective transmitter. | d. Refer to chart 7-3. |
| 6. | No interphone signal. | a. "TRANS" selector switch in wrong position. | a. Set "TRANS" switch to "INT" or any other unused crystal position. |
| | | b. Microphone or headset not plugged in. | b. Connect microphone or headset. |
| 7. | No transmission. | a. "VHF" "OFF" control not turned on; R-15 dynamotor not operating. | a. Turn "OFF" control full counterclockwise. |
| | | b. "TRANS" switch in wrong position. | b. Set "TRANS" to desired frequency channel. |

CHART 7-1, TROUBLE SHOOTING B-50 RADIO EQUIPMENT (CONT'D)

| | | |
|---|---|---|
| c. | Defective crystal. | c. Replace with spare crystal if available or use another frequency. |
| d. | Antenna not connected. | d. Connect antenna. |
| e. | Microphone button not depressed, or defective. | e. Press microphone button or replace microphone. |
| f. | Microphone not connected. | f. Connect microphone. |
| g. | Defective transmitter. | g. Refer to chart 7-3. |

CHART 7-2, TROUBLE SHOOTING R-11A AND R-15 RECEIVERS

| | TROUBLE | | PROBABLE CAUSE | CORRECTION |
|---|---|---|---|---|
| 1. | Dynamotor not operating. | a. | Low battery voltage. | a. Replace or recharge airplane battery. |
| | | b. | Loose primary power cable connection. | b. Check cable connections from source to receiver. |
| | | c. | Wrong cable connections. | c. Check cable connections. |
| | | d. | Defective fuse. | d. Check fuses and replace if defective. |
| | | e. | Defective dynamotor. | e. Replace dynamotor. |
| 2. | Dynamotor operating but no output. | a. | Worn brushes. | a. Replace brushes. |
| | | b. | Dirty commutator. | b. Refinish commutator. |
| | | c. | Open or shorted armature windings. | c. Replace. |
| | | d. | Defective output connections. | d. Check and repair connections. |
| 3. | No audible signal. | a. | Defective tubes. | a. Test and replace defective tubes. |
| | | b. | Dynamotor not operating. | b. Refer to 1, this table. |
| | | c. | Dynamotor operating but no output. | c. Refer to 2, this table. |
| | | d. | Defective fuse. | d. Check fuses and replace if defective. |
| | | e. | Shorted or open winding in output transformer. | e. Check and replace if defective. |
| | | f. | No screen voltage to any tube. | f. Voltage dropping resistor probably open. Replace if defective. |
| 4. | Distortion (abnormal noise) in signal in R-11A. | a. | No avc. | a. Check and replace V-604 if defective. |
| | | b. | Improper avc action. | b. Check and replace V-604 if defective. |
| | | c. | Improper avc action. | c. Check and replace R-628 if defective. |
| | | d. | Poor antenna connections. | d. Check and repair antenna. |
| | | e. | Defective tube. | e. Test all tubes and replace those which are defective. |
| 5. | Faint or fading signal. | a. | Defective tube. | a. Test all tubes and replace those which are defective. |
| | | b. | Receiver out of alignment. | b. Send to a BEECHCRAFT Certified Service Station. |
| | | c. | Defective dynamotor. | c. Check and replace if defective. |
| 6. | Receiver overloads on strong signal (improper avc). | a. | Defective avc tube in R-11A. | a. Check V-604 and replace if defective. |
| | | b. | Defective avc rectifier or avc limiter in R-15. | b. Check V-306 and V-307 and replace if defective. |
| | | c. | Leakage from high voltage supply to avc diode rectifier in R-11A. | c. Check C-627 and replace if open or shorted |
| | | d. | Defective coupling to anode of limiter in R-11A. | d. Check C-626C and replaced if defective. |
| | | e. | Open cathode by-pass in audio amplifier circuit (audio gain very low) in R-11A. | e. Check C-637 and replace if defective. |
| | | f. | Defective r-f amplifier tube or mixer tube in R-15. | f. Check V-301, V-302 and V-303 and replace defective tubes. |

CHART 7-2, TROUBLE SHOOTING R-11A AND R-15 RECEIVERS (CONT'D)

| | | |
|---|---|---|
| | g. C-151 or C-351 defective, (coupling to avc rectifier in R-15). | g. Replace C-151 or C-351. |
| | h. R-135 or R-335 open or high resistance in R-15. | h. Check with multimeter and replace if necessary. |
| 7. High noise level. | a. Defective mixer tube in R-11A. | a. Test V-602 and replace if necessary. |
| | b. Defective noise limiter tube in R-11A. | b. Test V-605 and replace if necessary. |
| | c. Defective noise limiter in R-15. | c. Check V-108 or V-308 and replace if defective. |
| | d. Defective coupling limiter to final a-f stage in R-15. | d. Check C-163 or C-363 and replace if defective. |
| | e. Worn dynamotor brushes or pitted commutator. | e. Replace commutator. |
| 8. Abnormal frequency drift. | a. Low battery voltage. | a. Replace or recharge airplane battery. |
| | b. Defective oscillator tube. | b. Test V-602 in R-11A and V-104 or 304 in R-15. Replace if defective. |

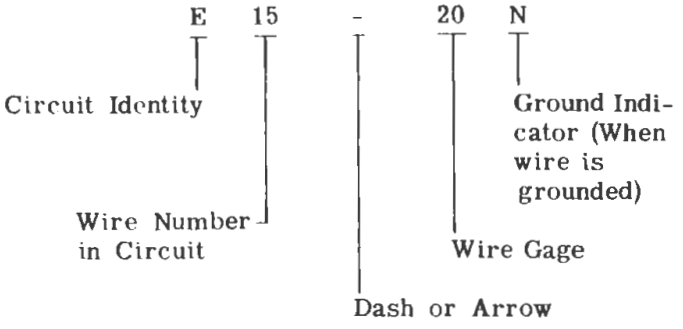
CHART 7-3, TROUBLE SHOOTING T-11B TRANSMITTER

| TROUBLE | PROBABLE CAUSE | CORRECTION |
|---|---|---|
| 1. No output. | a. Incorrect cable connections from associated receiver. | a. Check cable connections. |
| | b. Defective high voltage supply. | b. Check receiver dynamotor. |
| | c. Defective crystal. | c. Replace defective crystal. |
| | d. Defective tube. | d. Test all tubes and replace defective tube. |
| 2. No high voltage. | a. Defective receiver dynamotor. | a. Replace dynamotor. |
| | b. Defective high voltage relay. | b. Replace K-202. |
| | c. Defective microphone. | c. Replace microphone. |
| 3. No output connection to antenna. | a. Insecure or improper cable connections. | a. Check cable connections. |
| | b. Defective antenna relay. | b. Replace K-201. |
| 4. Frequency coverage incomplete. | a. Improper alignment. | a. Realign tuned circuit. |
| 5. No side tone. | a. Defective modulator. | a. Replace V-204. |
| | b. Defective coupling capacitor. | b. Replace C-201. |
| | c. Defective microphone. | c. Replace microphone. |
| 6. Incorrect frequency transmission. | a. Crystal selector switch in wrong position. | a. Check selector switch position. |
| | b. Incorrect crystal frequency. | b. Check crystal frequency. |
| | c. Tuned circuit not resonated properly. | c. Realign circuit. |

# PART VIII

## WIRING DIAGRAMS

The wire codes on all individual circuit diagrams included in this section are identified by letters, wire numbers, and wire sizes. An example of the numbering system is shown as follows:




The letter preceding the wire number identifies the circuit in which the wire is used. The following letter codes are used to identify various circuits.

| | |
|---|---|
| A | Armament |
| B | Photographic |
| C | Control Surfaces |
| D | Instruments (other than flight or engine) |
| E | Engine Instruments |
| F | Flight Instruments |
| G | Landing Gear |
| H | Heating, Ventilating and Deicing |
| J | Ignition |
| K | Engine Controls |
| L | Lighting |
| M | Miscellaneous |
| N | Ground (used as suffix letter after code) |
| P | Direct Current Power |
| Q | Fuel and Oil |
| R | Radio - Navigation and Communication |
| S | Radar |
| T | Special Electronic |
| W | Warning and Emergency |
| X | Alternating Current Power |

## EQUIPMENT LIST, ELECTRICAL SYSTEM

| ITEM | NOMENCLATURE | PART NUMBER |
|---|---|---|
| 1 | Terminal Post - Main Belly | 814-180537 |
| 2 | Battery - 12V | R-33 |
| 3 | Relay - Battery | 6041H105A |
| 4 | Switch - Battery on-off | AN3021-2 |
| 5 | Bus Bar - LH Subpanel | 50-364039 |
| 6 | Bus Bar - RH Subpanel | 108446-11 |
| 7 | Receptacle - External Power | AN2552-A3A |
| 8 | Switch - Battery (Lock) | 50-364122 |
| 9 | Bus Cable | 50-361224-6 |
| 10 | Bus Cable | 50-361224-14 |
| 11 | Bus Cable | 50-361224-10 |
| 12 | Bus Cable | 50-361224-2 |
| 13 | Bus Cable | 50-361248-2 |
| 14 | Bus Cable | 50-361248-6 |
| 15 | Bus Bar - Starter Relay | 50-361213 |
| 16 | Bus Bar - Prop Feather | 108446-3 |
| 17 | Bus Bar - Gen Circuit Breaker | 50-364169 |
| 18 | Circuit Breaker, Flaps | PSM-20 |
| 19 | Switch - Flap Control | 35-364059 |
| 20 | Light, Flap up Position | 217H |
| 21 | Light, Flap Down Position | 217H |
| 22 | Resistor-Flap Light Dim | RW31F251 |
| 23 | Motor, Flap | 50-364090 |
| 24 | Light, Flap 20 degree down | 217H |
| 25 | Switch, Flap Lower Limit | 50-36122B |
| 26 | Switch, Flap Up Limit | 50-361229 |
| 27 | Switch, 20 Degree Down | 50-361227 |
| 28 | Lamp, Indicator | AN3121-313 |
| 29 | Circuit Breaker - Horn | PSM-5 |
| 30 | Circuit Breaker-Landing Gear Ind. | PSM-5 |
| 31 | Circuit Breaker-Landing Gear Control | D-675-1-1-5 |
| 32 | Circuit Breaker-Landing Gear Motor | PLM-50 |

| ITEM | NOMENCLATURE | PART NUMBER |
|---|---|---|
| 33 | Horn-Landing Gear Warning | 318 |
| 34 | Switch - Throttle | V3-1 Switch<br>JV-5 Actuator |
| 35 | Switch - LH Gear Down Lock | AN3210-1 |
| 36 | Switch - RH Gear Down Lock | AN3210-1 |
| 37 | Switch-Landing Gear Safety | AN3216-1 |
| 38 | Switch-Nose Gear Down Lock | AN3210-1 |
| 39 | Switch - Landing Gear Up Limit | AN3210-1 Switch<br>MC-2711 Actuator |
| 40 | Switch-Landing Gear Down Limit | AN3210-1 Switch<br>MC-2711 Actuator |
| 41 | Switch - Landing Gear Control | AN3226-3 |
| 42 | Light - Landing Gear Down Indicator | 217H |
| 43 | Light - Landing Gear Up Indicator | 217H |
| 44 | Motor, Landing Gear Retract | 50-810146 |
| 45 | Relay - Landing Gear Control | 6046H39A |
| 46 | Resistor - Down Light Dim | RW31F251 |
| 47 | Resistor - Up Light Dim | RW31F251 |
| 48 | Disconnect Splice - Landing Gear Circuit | YZ18-H1 |
| 49 | Flasher - Landing Gear Warning | #611 (600MA) |
| 50 | Lamp-Indicator | AN3121-313 |
| 51 | Circuit Breaker | 8733 |
| 52 | Switch - Air Valve | AN3210-1 |
| 53 | Thermostat - Cabin | 9653-2-90° |
| 54 | Thermostat - Cyclic | 112447-B-RC-C-150 |
| 55 | Thermostat - High Heat | 112447-S-1C-C-300T |
| 56 | Motor, Blower | 50-554119 |
| 57 | Heater | 50-555119 |
| 58 | Igniter | Type 1C |
| 59 | Valve - Fuel | 12257-24 |
| 60 | Pump - Fuel | 476439 |
| 61 | Disconnect Splice - Cabin Heater Circuit | YZ18-H1 |
| 62 | Box Assembly - Relay Control | 51B542 (51B542-1, 50-364170)* |
| 63 | Cable - Heater Ignition | 50-364127 |
| 64 | Resistor | 3 ohm. 10 Watt<br>Brown Devil |
| 65 | Rheostat - Cabin Temperature Selector | 0158 (0158-355)* |
| 66 | Filter - Blower Motor | AS135 |
| 67 | DELETED* | 112447-B-RC-C-75 |
| 68 | Terminal Strip | AN3435-2-7 |
| 69 | Fuse | NAS-441-3-5 |
| 70 | Circuit Breaker - Cigarette Lighter and Step. | PSM-15 |
| 71 | Switch - Landing Gear Strut | AN3210-1 |
| 72 | Switch - Step Up Limit | AN3210-1 |
| 73 | Switch - Step Down Limit | AN3210-1 |
| 74 | Motor- Step | 50-364068 |
| 75 | Plug - Step Motor | AN3106-10SL-3S |
| 76 | Cigarette Lighter - 12 Volt | 35-364060 |
| 77 | Disconnect Splice - Step Motor and Cigarette Lighter Circuit | YZ18-H1 |
| 78 | Resistor - 1 ohm 50 Watt | Type 4-1/2C |
| 79 | Light - Stall Warning | Type 130-AR |
| 80 | Horn - Stall Warning | 1-02-000 Model S |
| 81 | Switch - Stall Warning | 151 |
| 82 | Circuit Breaker | 8730 |
| 83 | Disconnect Splice - Pitot Heat Circuit | YZ14-H1 |
| 84 | Pitot Heat Tube | 782-02 |
| 85 | Circuit Breaker | AN3161P20 |
| 86 | Receptacle - Firewall Prop Feathering Circuit | AN3100-32-6P |
| 87 | Plug - Firewall Prop Feathering Circuit | AN3106-32-6S |
| 88 | Bus Bar | 50-360003-2 |
| 89 | Relay | AN3350-1 |
| 90 | Switch - Unfeather Limit | AN3210-1 |

*Per Service Bulletin No. 9

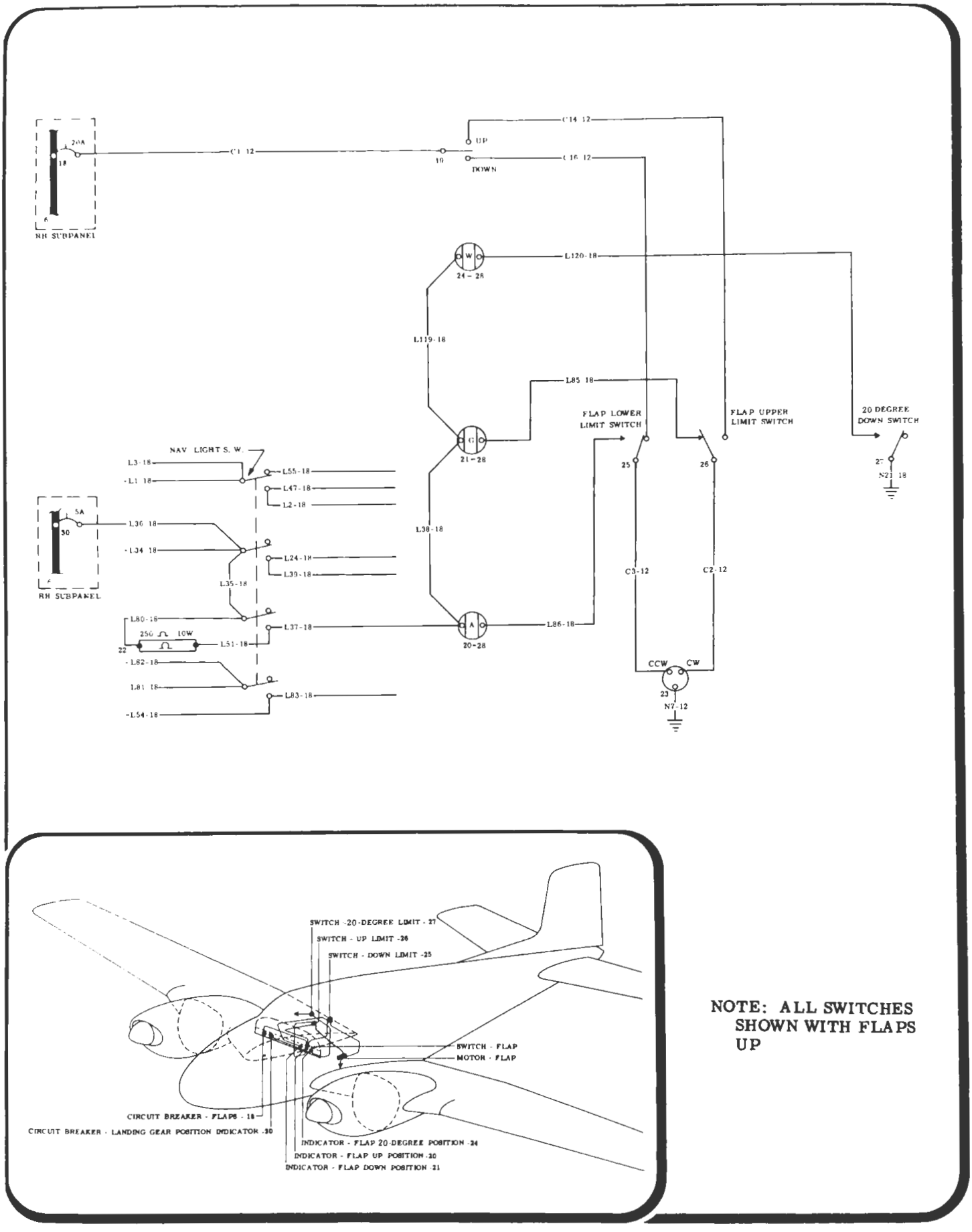
| ITEM | NOMENCLATURE | PART NUMBER |
|---|---|---|
| 91 | Switch - Feathering Control | AN3210-1 |
| 92 | Switch - Feather Limit | AN3210-1 |
| 93 | Feathering - Motor | 1S14347 |
| 94 | Receptacle - Baffle | AN3100-18-9P |
| 95 | Plug - Baffle | AN3106-18-9S |
| 96 | Indicator - Oil Temperature | 50-320101 |
| 97 | Plug - Oil Temperature Indicator | AN3106-14S-2S |
| 98 | Circuit Breaker - Oil Temp. Indicator | PSM-5 |
| 99 | Receptacle - Firewall Oil Temp. Indicator Circuit | AN3100-32-6P |
| 100 | Plug - Firewall Oil Temperature Indicator Circuit | AN3106-32-6S |
| 101 | Bulb Assembly - Oil Temperature | 56B15 |
| 102 | Plug - Oil Temperature Bulb | AN3106-12S-3S |
| 103 | Circuit Breaker- Fuel Booster Pumps | PSM-5 |
| 104 | Bus Strap | 108446-2 |
| 105 | Terminal Block | AN3436-2-2 |
| 106 | Pump - Fuel Booster | 50-920073 |
| 107 | Condenser | AS185 |
| 108 | Circuit Breaker - Fuel Quantity Indicator | PSM-5 |
| 109 | Resistor | 75 ohm - 10 Watt Brown Devil |
| 110 | Resistor | 4154455 |
| 111 | Transmitter - LH Outboard | 50-369020 |
| 112 | Transmitter - LH Inboard | 50-369019 |
| 113 | Transmitter - RH Inboard | 50-369019 |
| 114 | Transmitter - RH Outboard | 50-369020 |
| 115 | Indicator - Fuel Quantity | 45-380017 |
| 116 | Bond Jumper | A-Q6Q |
| 117 | Bond Jumper | A-Q3P |
| 118 | Switch - Magneto On-Off | AN3021-2 |
| 119 | Bus Bar - Magneto Switches | 50-364038 |
| 120 | Filter - Magneto | 63149 |
| 121 | Magneto-- Engine Right | S6LN-50 |
| 122 | Magneto - Engine Left | S6LN-51 |
| 123 | Indicator - Tachometer | 50-320107 |
| 124 | Plug - Tachometer Indicator | AN3106-14S-1S |
| 125 | Receptacle - Firewall Tachometer Circuit | AN3100-32-6P |
| 126 | Plug - Firewall Tachometer Circuit | AN3106-32-6S |
| 127 | Plug - Tachometer Generator | AN3106-14S-1S |
| 128 | Generator - Tachometer | 1001G-01 |
| 129 | Indicator - Cylinder Head Temperature | 50-320102 |
| 130 | Resistor | AN5534-1 |
| 131 | Thermocouple | AN5541-1 |
| 132 | Circuit Breaker - Turn and Bank Indicator | PSM-5 |
| 133 | Indicator - Turn and Bank | 50-320111 |
| 134 | Circuit Breaker - Generator | D6751-1-50 |
| 135 | Switch - Generator Control | AN3027-2 |
| 136 | Voltammeter | 50-320123 |
| 137 | Regulator - Voltage | 1042-17 or 1589-1 |
| 138 | Relay - Reverse Current | AN3025-1 |
| 139 | Resistor - Generator Equalizer | 1002 |
| 140 | Resistor - Generator Equalizer | AVO-1050 |
| 141 | Shunt - Ammeter | 258X8 |
| 142 | Receptacle - Firewall Generator Circuit | AN3100-32-6P |
| 143 | Plug - Firewall Generator Circuit | AN3106-32-6S |
| 144 | Bus - Generator Shunt LH | 50-364059 |
| 145 | Bus - Generator Shunt RH | 50-364070 |
| 146 | Condenser - Generator Control | CA-275X |
| 147 | Generator | 24225-Type M2 |
| 148 | Circuit Breaker - Primers and Starters | PSM-5 |
| 149 | Switch - Starter on-off | 7196-K1 |
| 150 | Relay - Starter | 6041H202 |
| 151 | Receptacle - Firewall Primer and Starter Circuits | AN3100-32-6P |
| 152 | Plug - Firewall Primer and Starter Circuits | AN3106-32-6S |

| ITEM | NOMENCLATURE | PART NUMBER |
|---|---|---|
| 153 | Motor - Starter | 756-56B |
| 154 | Bus Cable | 50-361224-18 |
| 155 | Switch - Primer | 7196-K1 |
| 156 | Primer | 12257-12 |
| 157 | Circuit Breaker - Baggage and Instrument Light | PSM-5 |
| 158 | Switch - Rear Baggage Light | AN3210-1 |
| 159 | Switch - Nose Baggage Light | BZ-3YT |
| 160 | Lamp - Red Instrument - Outboard on Light Panel | AN3124-307 |
| 161 | Lamp - Map Reading | AN3124-307 |
| 162 | Lamp - Red Tab Indicator on Pedestal | AN3121-R313 |
| 163 | Lamp - Rear Baggage Compartment | 305 |
| 164 | Lamp - Nose Baggage Compartment | 305 |
| 165 | Disconnect Splice - Map Baggage and Red Instrument Light | YZ18-H1 |
| 166 | Light - Map | 2611 |
| 167 | Light - Red Instrument | 2505 |
| 168 | Light - Forward Baggage Compartment | 2611 |
| 169 | Switch - Dim Selector | 3226J |
| 170 | Switch - Dim Selector | 32112J |
| 171 | Resistor | 1007 |
| 172 | Resistor | 1010 |
| 173 | Resistor | 1011 |
| 174 | Resistor | 0362 |
| 175 | Resistor | 125 ohm 10 Watt Brown Devil |
| 176 | Lamp - Red Instrument - Inboard on Light Panel | AN3131-303 |
| 177 | Light | 705 |
| 178 | Lamp | AN3121-1819 |
| 179 | Circuit Breaker - Navigation Lights | PSM-5 |
| 180 | Switch - Navigation Light on-off | 8884K4 |
| 181 | Filter - Radio | K-11178 |
| 182 | Lamp - Landing Gear Position (Mechanical Indicator) | AN3121-313 |
| 183 | DELETED | |
| 184 | Disconnect - Splice Navigation Light | YZ14-H1 |
| 185 | Navigation Lamp - Right Wing | 50-361110-4 |
| 186 | Navigation Lamp - Left Wing | 50-361110-2 |
| 187 | Navigation Lamp - Tail | AN3158-1 |
| 188 | Light - Navigation | 209 |
| 189 | Resistor | RW31F251 |
| 190 | Circuit Breaker - Landing Light | 8732 |
| 191 | Lamp - Landing | 4523 |
| 192 | Circuit Breaker - Passing Lamp | AN3160-5 |
| 193 | Light - Passing | AN3144R505 |
| 194 | Circuit Breaker - Cabin and Ultra-Violet Lights | PSM-5 |
| 195 | Switch - Ultra-Violet Light Control | 3226-J |
| 196 | Switch - Door Actuated | 50-364049 |
| 197 | Switch - Manual Cabin and Step | 8480 |
| 198 | Lamp - Cabin Dome | 303 |
| 199 | Lamp - Cabin Step | AN3141-301 |
| 200 | Lamp - Instrument Ultra-Violet | F2T6/BL |
| 201 | Light - Cabin and Step | SC2611 |
| 202 | Light - Instrument Ultra-Violet | 2844 |
| 203 | Resistor - Ultra-Violet Light Dim | 1010 |
| 204 | Resistor - Ultra-Violet Light Dim | 0364B |
| 205 | Resistor - Ultra-Violet Light Filament | 150 ohm 10 Watt Brown Devil |
| 206 | Resistor - Ultra-Violet Light ARC | 75 ohm 10 Watt Brown Devil |
| 207 | Actuator - Cabin Door Switch | MC-7711 |
| 208 | Disconnect Splice - Instrument U.V. Cabin Dome and Step Lights | YZ18-H1 |
| 209 | DELETED | |

| ITEM | NOMENCLATURE | PART NUMBER |
|---|---|---|
| 210 | Terminal Strip | 108446-2 |
| 211 | Quick Disconnect | YZ-10 |
| 212 | Resistor | Type BW-1, 1 Watt, 300 ohm |
| 213 | Capacitor | BRH605A, 500 MFD, 6-volt |
| 214 | Plug | AN3106B-105L-35 |

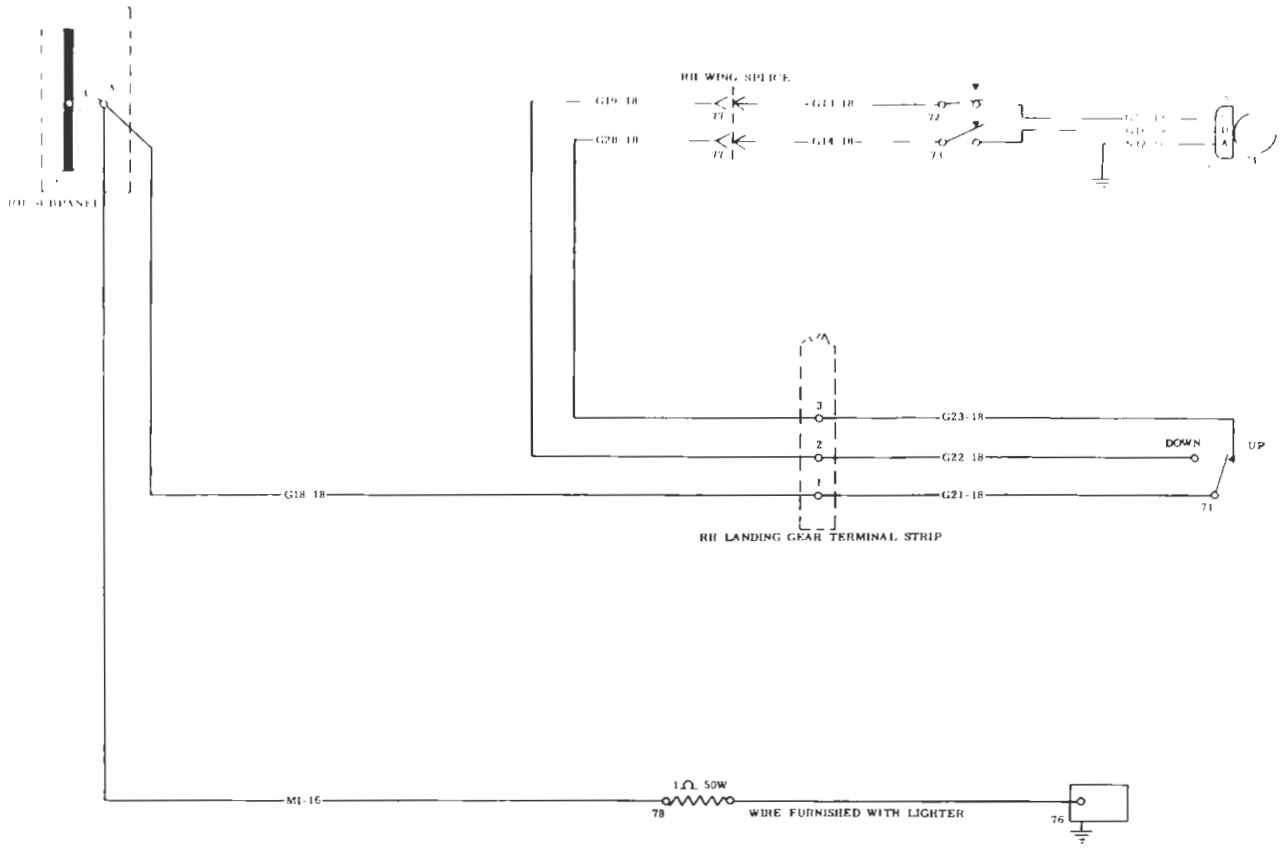
## EQUIPMENT LIST, RADIO

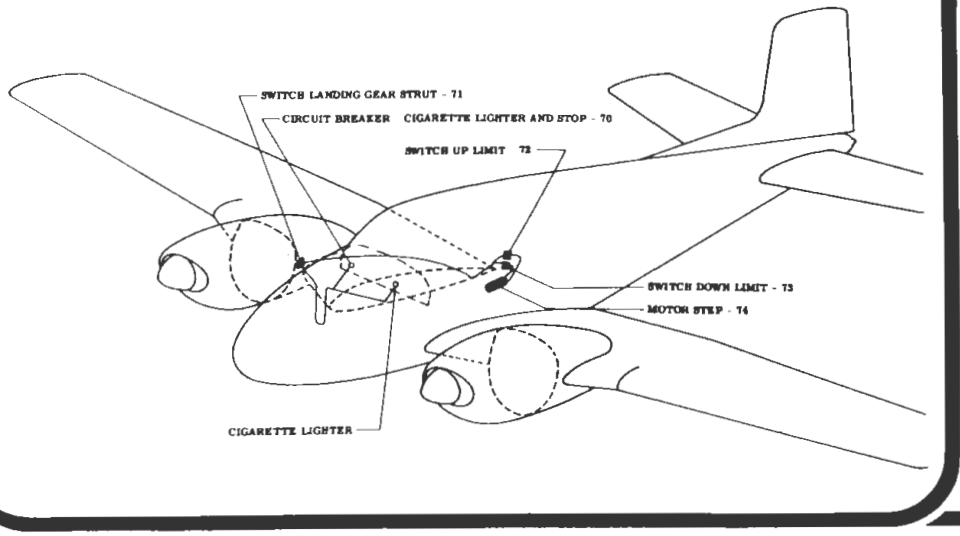
| ITEM | NOMENCLATURE | PART NUMBER |
|---|---|---|
| 1 | Junction Box Assembly | 50-344362 |
| 2 | Relay | 4QA14E4 |
| 3 | Radio Transmitter T-11B | 15840 28V |
| 4 | Radio Receiver R-15 | 12406 28V |
| 5 | Radio Receiver R-11A | 12404 28V |
| 6 | Mounting M-11A | 12501 |
| 7 | Mounting M-12A | 12502 |
| 8 | Dynamotor D-10A | 14402 |
| 9 | Control Assembly | 50-344048 |
| 10 | Antenna VHF | AN-104B |
| 11 | Antenna Range | 50-344007 |
| 12 | Overhead Speaker | S10340 |
| 13 | Rear Speaker | P8-T |
| 14 | Headphone Jack | SC-1A |
| 15 | Microphone Jack | SCA-2B |
| 16 | Circuit Breaker | PSM-5 |
| 17 | Bus Bar | 108446-2 |
| 18 | Cable | 50-344250 |
| 19 | Cable | 50-344249-5 |
| 20 | Connector | 12125 |
| 21 | Connector | 12139 |
| 22 | Connector | 12372 |
| 23 | Connector | 12332 |
| 24 | Connector | 12098 |
| 25 | Switch | AN3021-2 |
| 26 | Disconnect | YZ18-H1 |




NOTE: ALL SWITCHES SHOWN WITH FLAPS UP

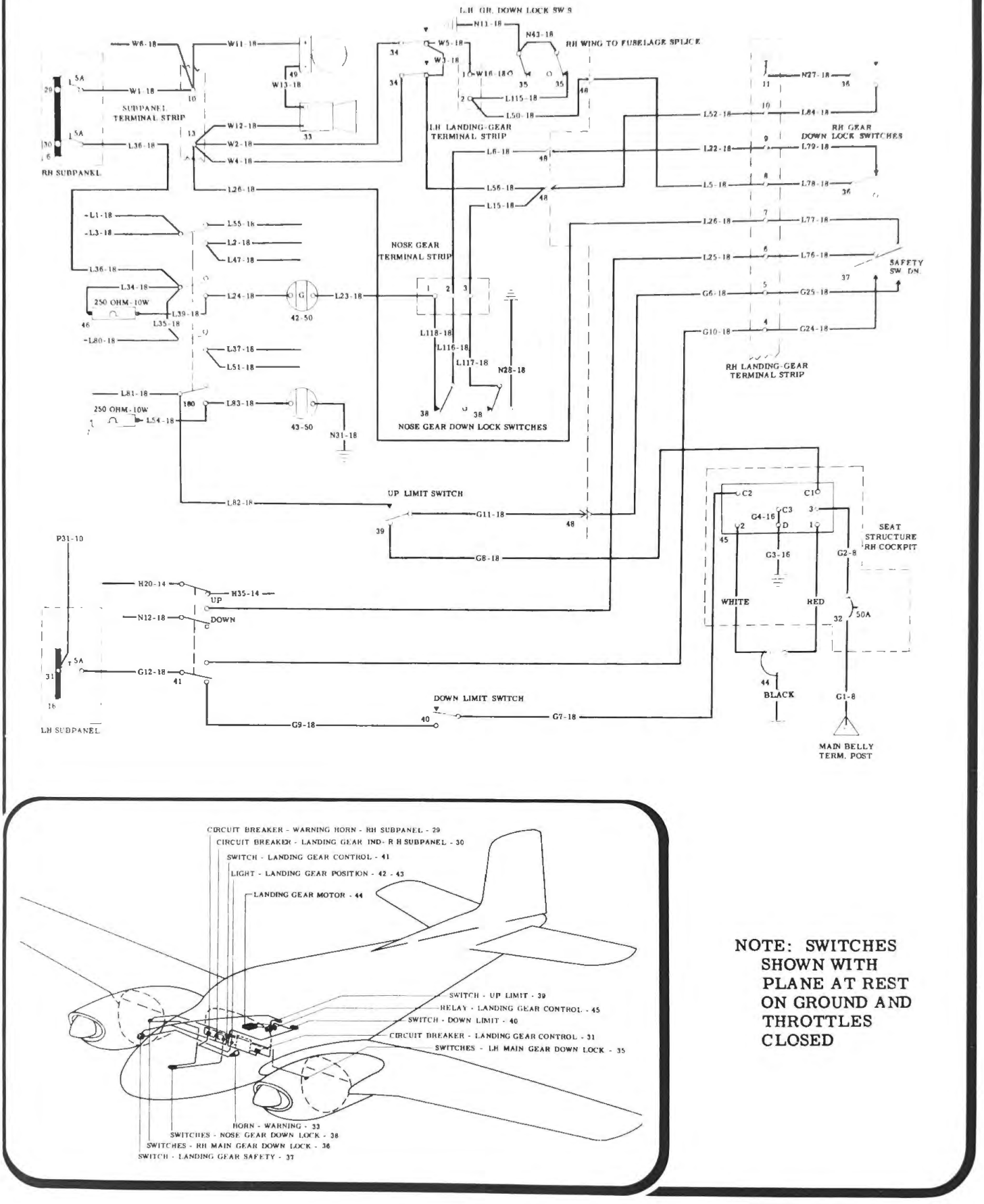
Figure 8-1. Wing Flap Circuits





SWITCH LANDING GEAR STRUT - 71
CIRCUIT BREAKER CIGARETTE LIGHTER AND STOP - 70
SWITCH UP LIMIT 72
SWITCH DOWN LIMIT - 73
MOTOR STEP - 74
CIGARETTE LIGHTER

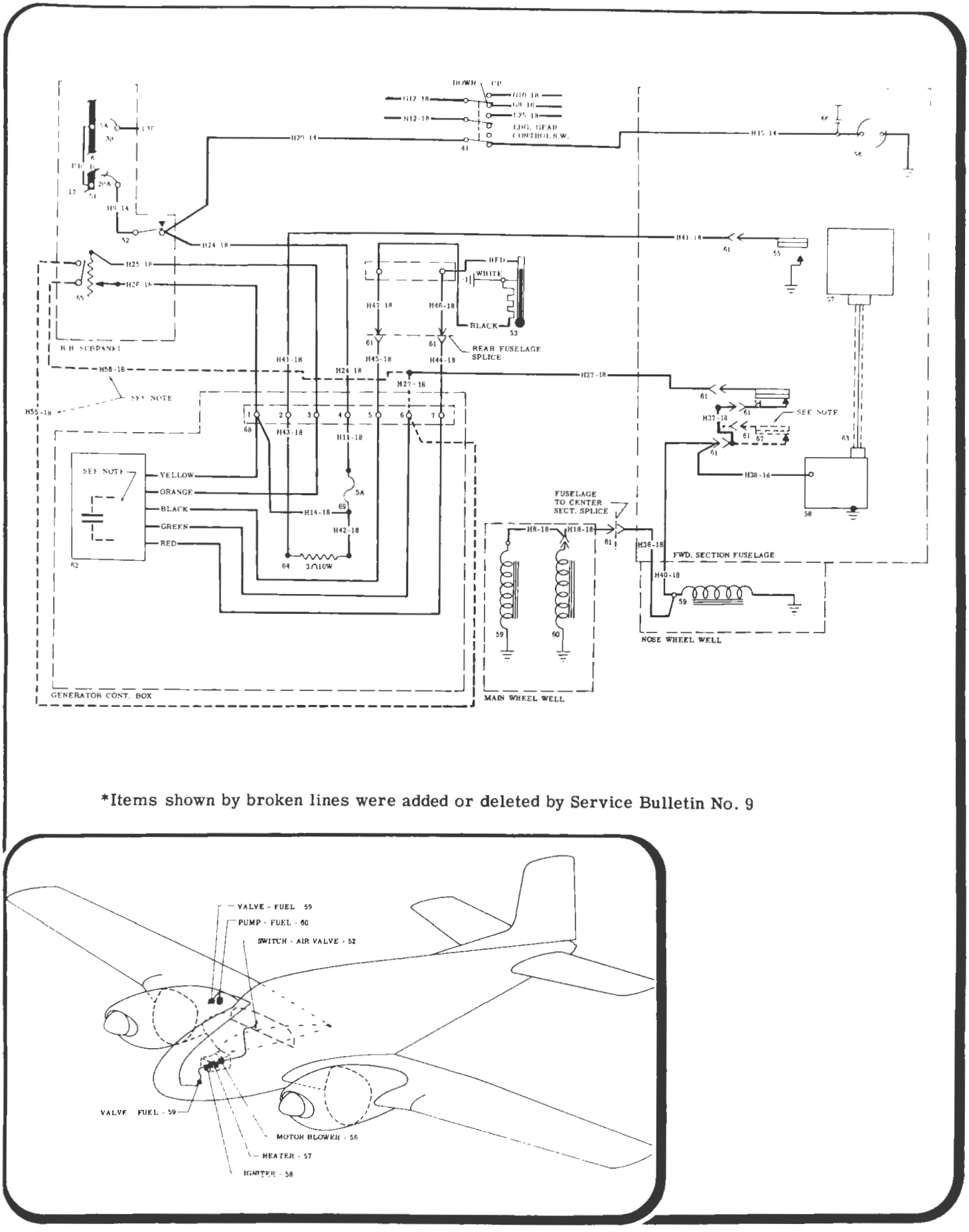
NOTE: SWITCHES SHOWN WITH AIRPLANE ON GROUND

Figure 8-2. Step Motor and Cigarette Lighter Circuits




NOTE: SWITCHES SHOWN WITH PLANE AT REST ON GROUND AND THROTTLES CLOSED

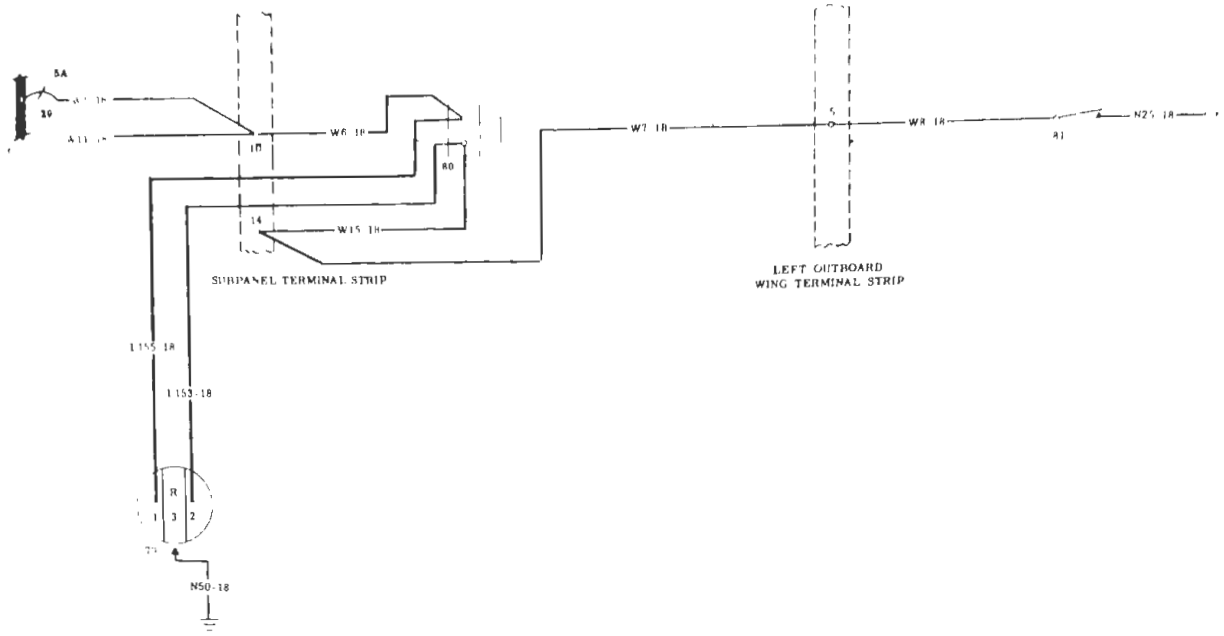
Figure 8-3. Landing Gear Circuits




*Items shown by broken lines were added or deleted by Service Bulletin No. 9




Figure 8-4. Cabin Heater Circuits



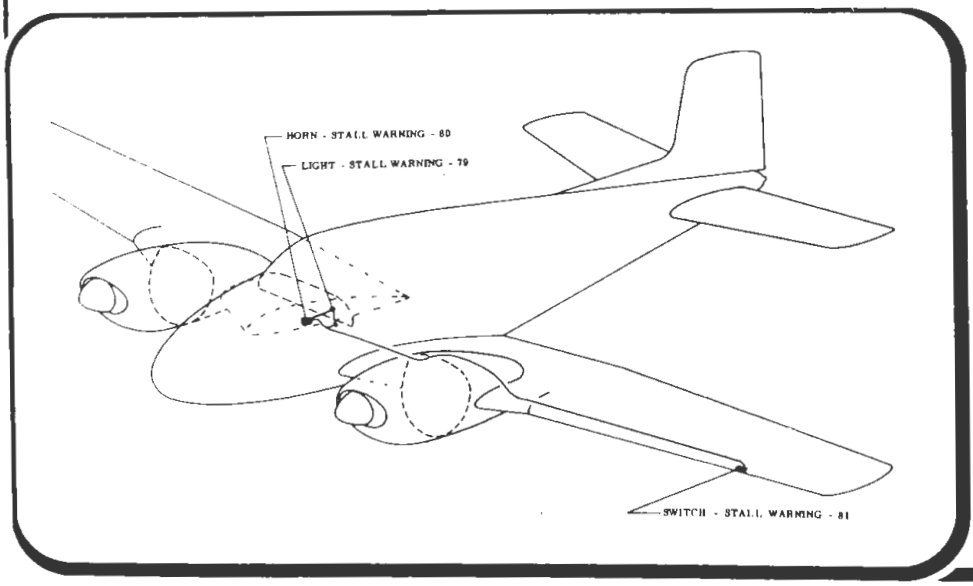




Figure 8-5. Stall Warning Indicator Circuit

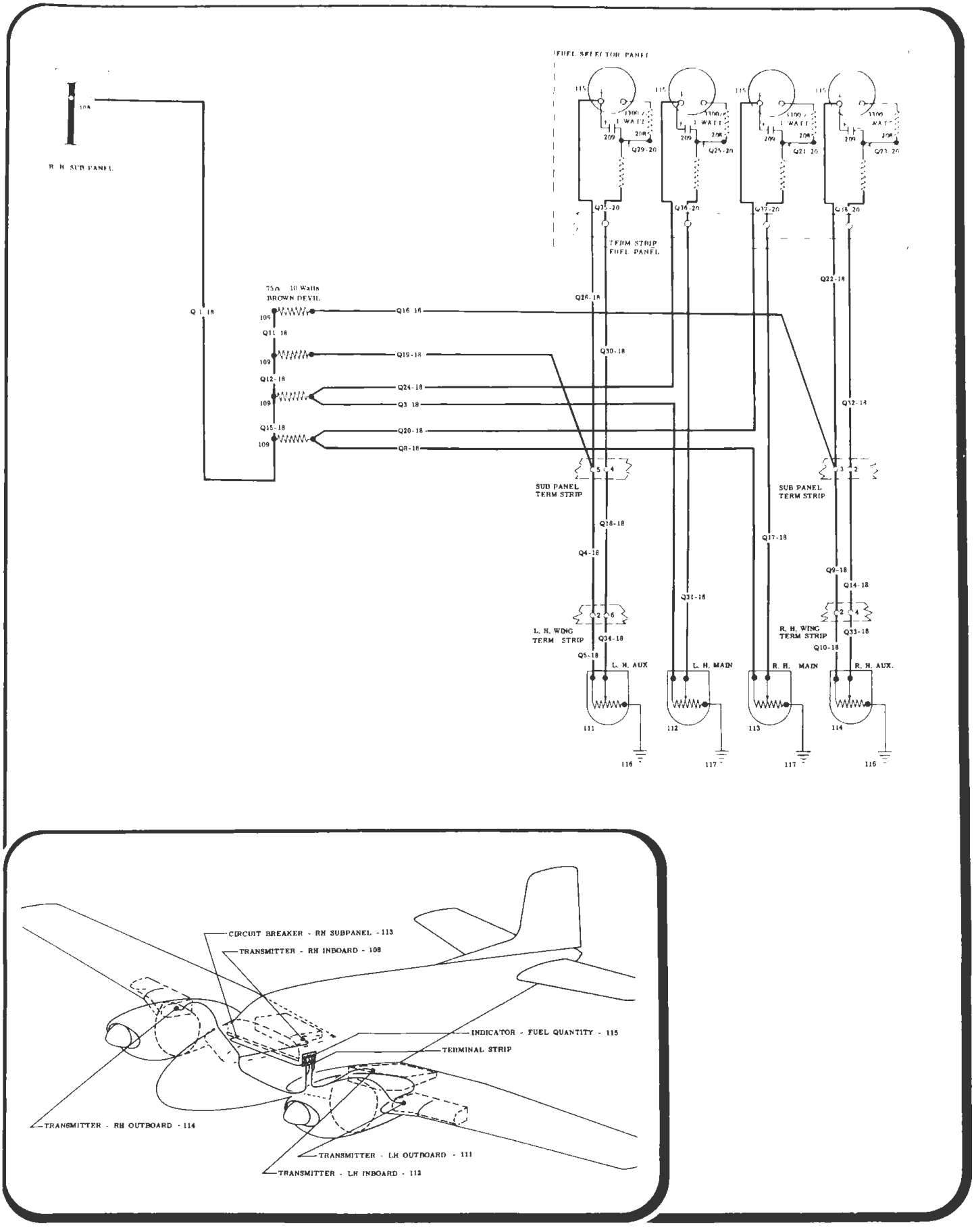
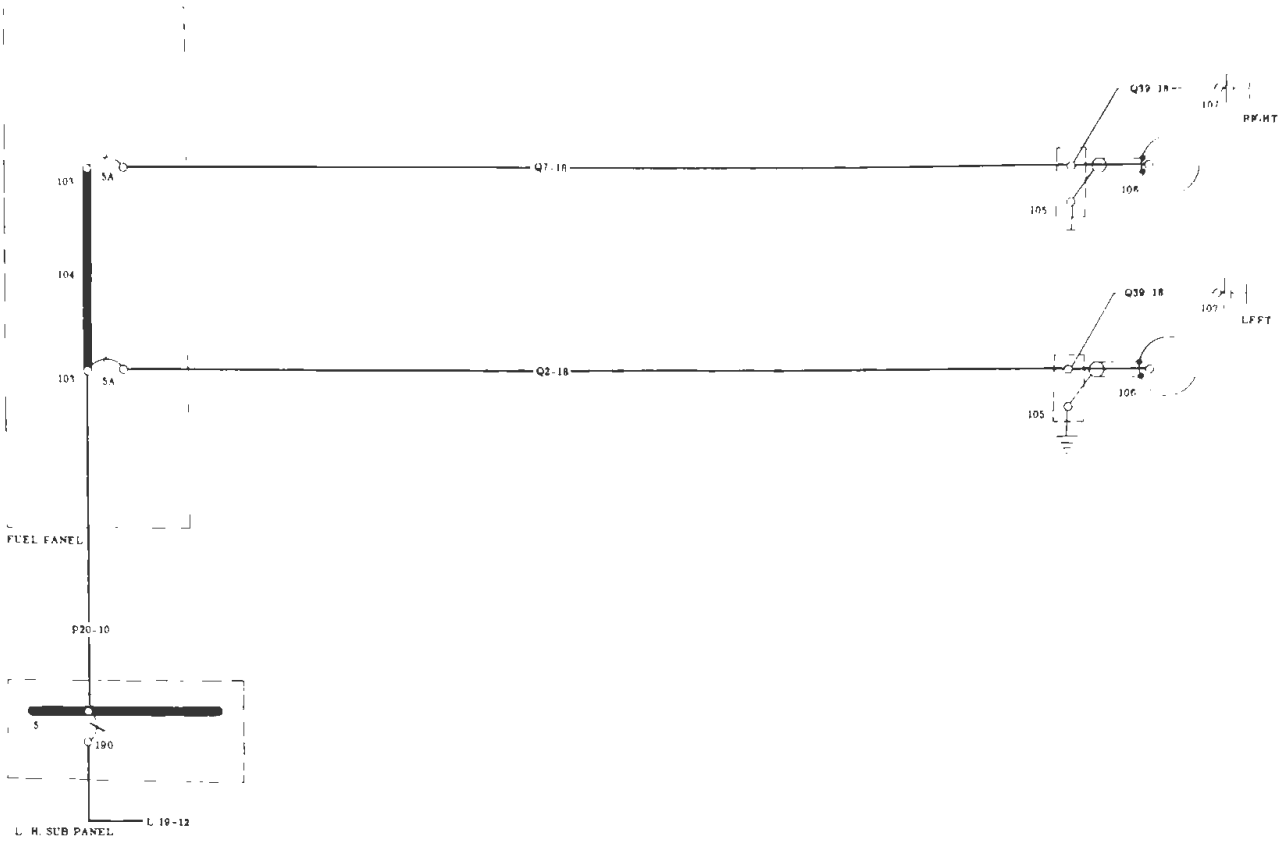

FUEL SELECTOR PANEL
R. H. SUB PANEL
TERM STRIP FUEL PANEL
SUB PANEL TERM STRIP
SUB PANEL TERM STRIP
L. H. WING TERM STRIP
R. H. WING TERM STRIP
L. H. AUX
L. H. MAIN
R. H. MAIN
R. H. AUX.
CIRCUIT BREAKER - RH SUBPANEL - 113
TRANSMITTER - RH INBOARD - 108
INDICATOR - FUEL QUANTITY - 115
TERMINAL STRIP
TRANSMITTER - RH OUTBOARD - 114
TRANSMITTER - LH OUTBOARD - 111
TRANSMITTER - LH INBOARD - 112

Figure 8-6. Fuel Quantity Indicator Circuits



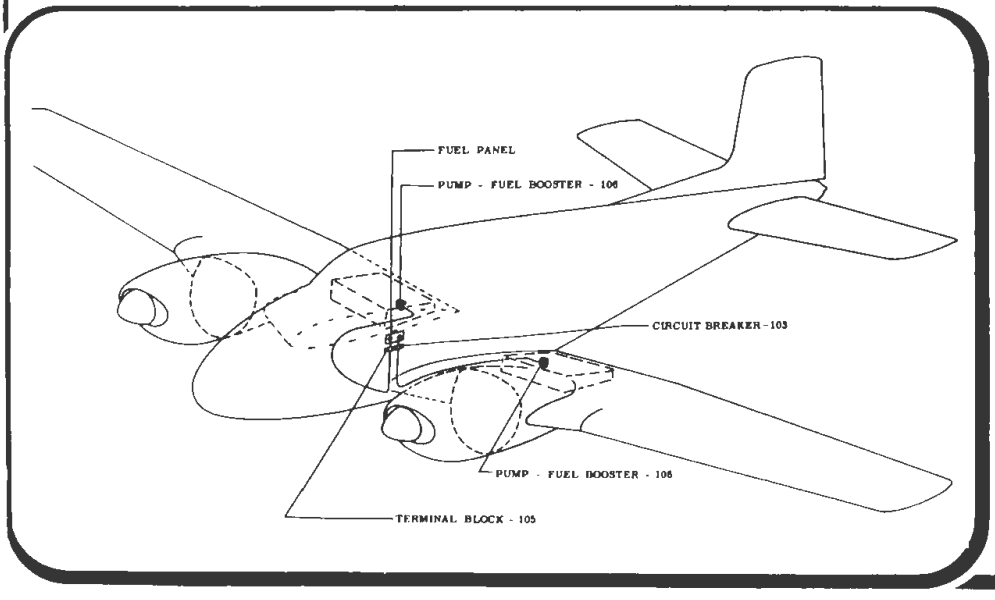
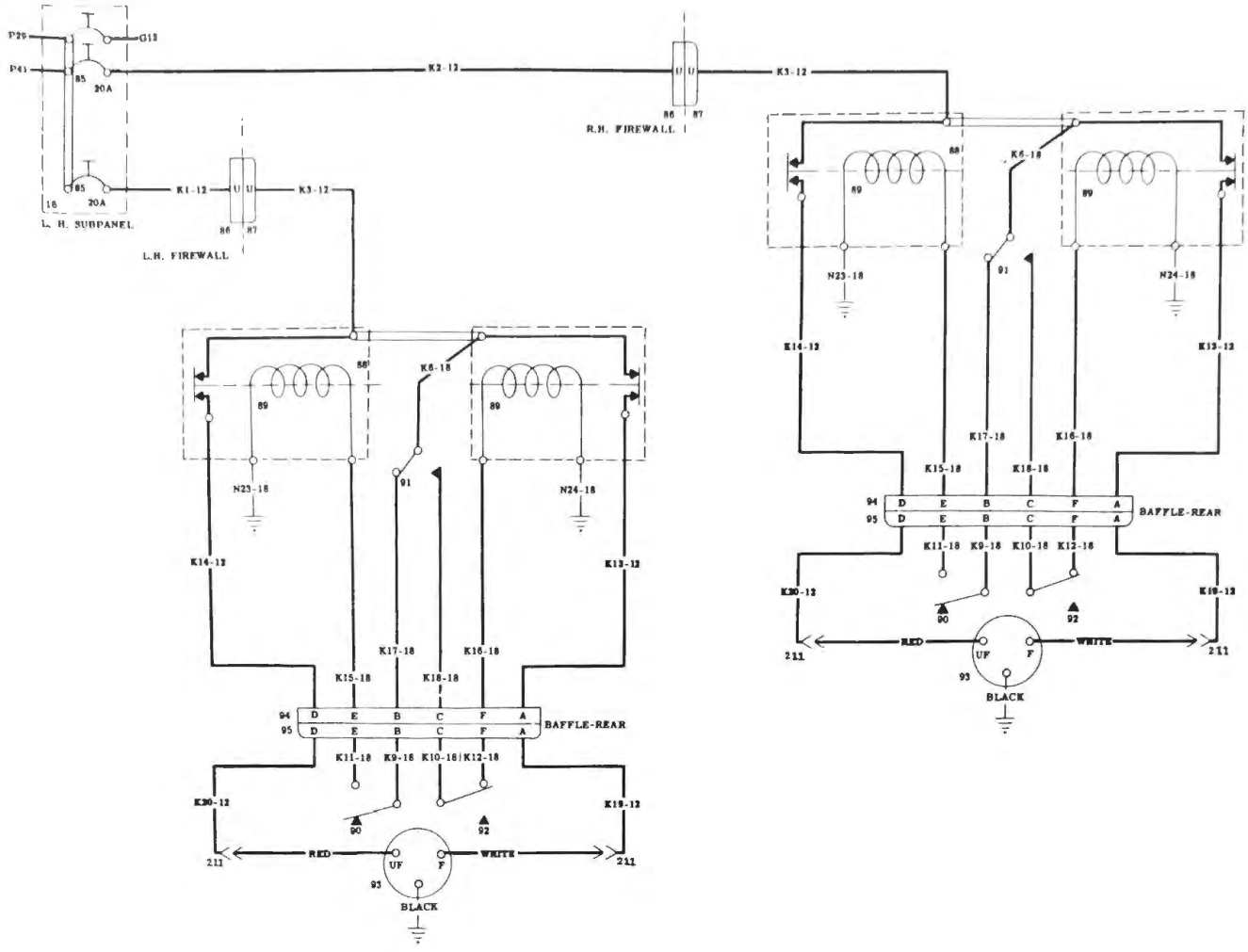
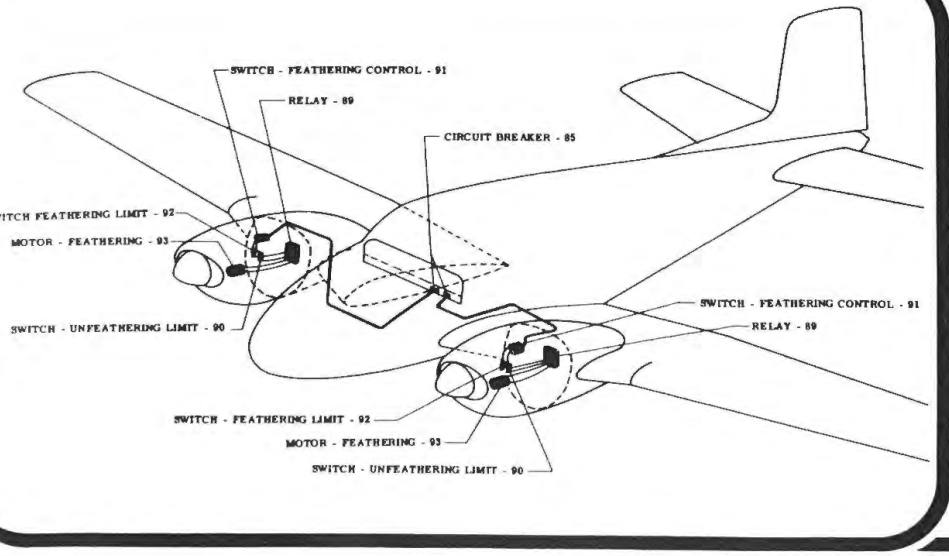



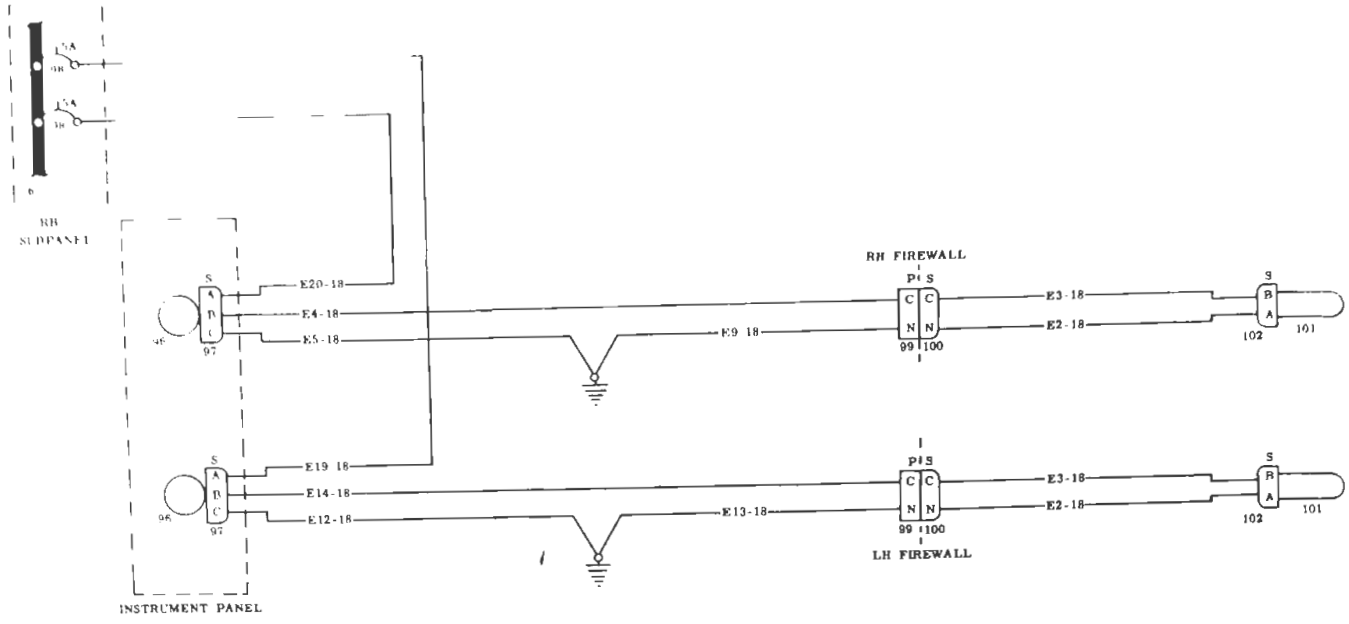

Figure 8-7. Fuel Booster Pump Circuits





SWITCH - FEATHERING CONTROL - 91
RELAY - 89
CIRCUIT BREAKER - 85
SWITCH FEATHERING LIMIT - 92
MOTOR - FEATHERING - 93
SWITCH - UNFEATHERING LIMIT - 90
SWITCH - FEATHERING CONTROL - 91
RELAY - 89
SWITCH - FEATHERING LIMIT - 92
MOTOR - FEATHERING - 93
SWITCH - UNFEATHERING LIMIT - 90

**NOTE: SWITCHES SHOWN WITH PROP IN UNFEATHERED POSITION**

Figure 8-8. Propeller Feathering Circuits



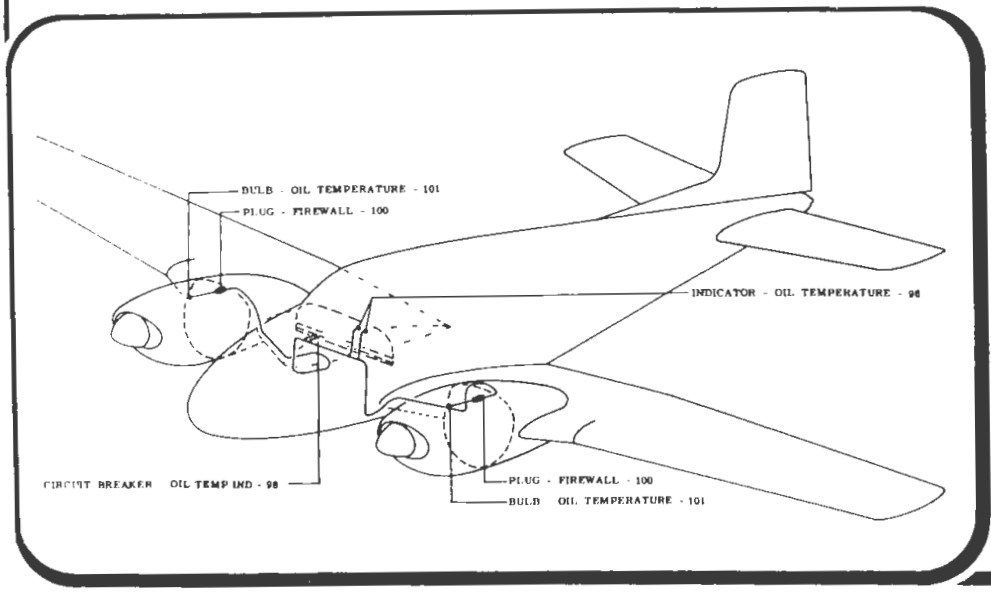
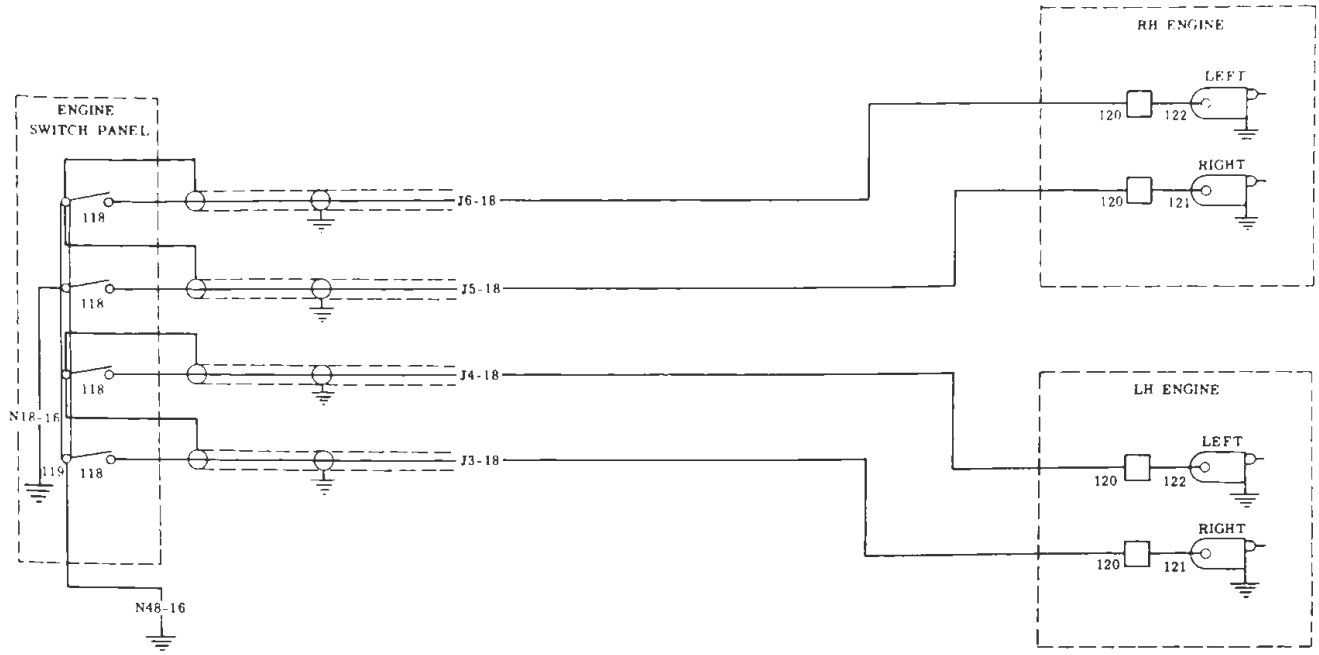


BULB - OIL TEMPERATURE - 101
PLUG - FIREWALL - 100
INDICATOR - OIL TEMPERATURE - 98
CIRCUIT BREAKER - OIL TEMP IND - 98
PLUG - FIREWALL - 100
BULB - OIL TEMPERATURE - 101

Figure 8-9. Oil Temperature Indicator Circuits



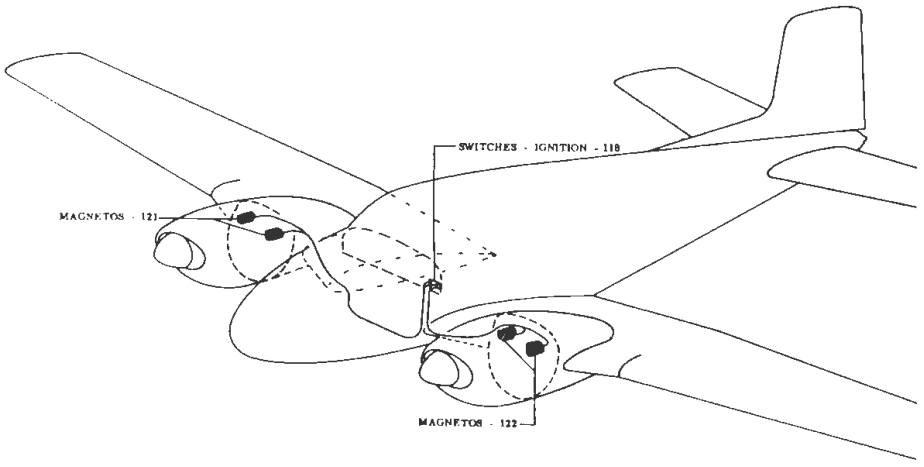
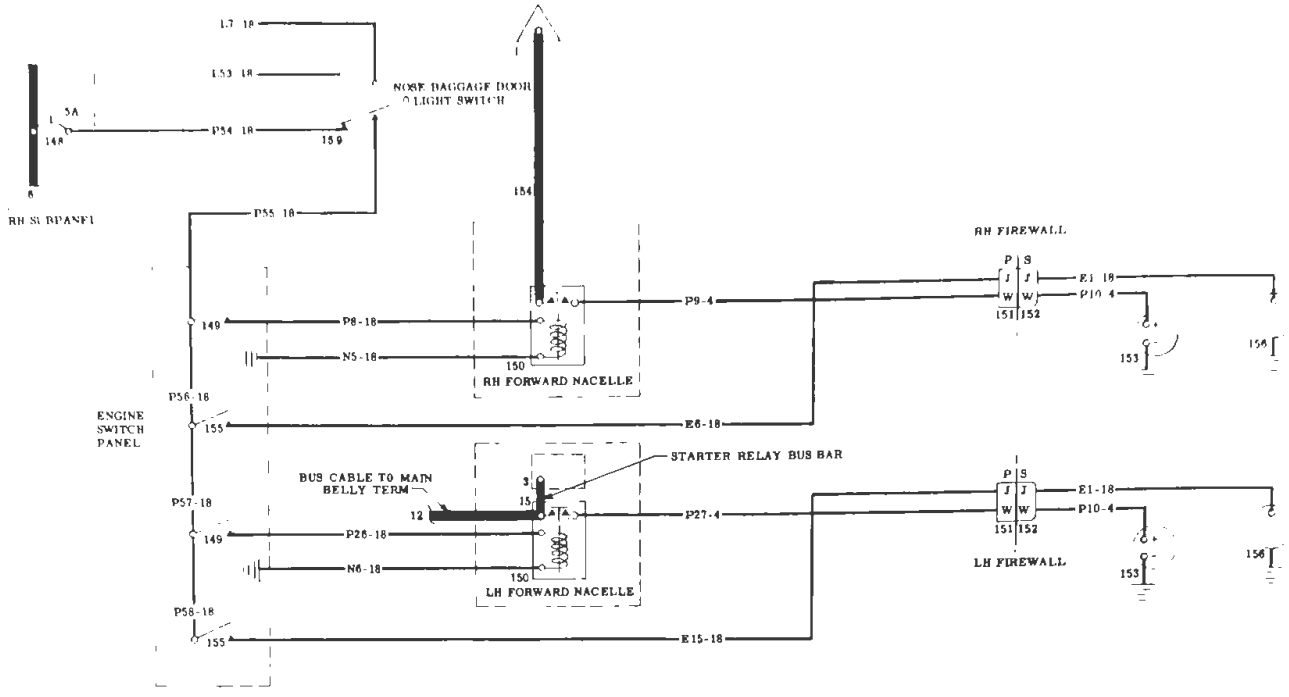




Figure 8-10. Ignition Circuits



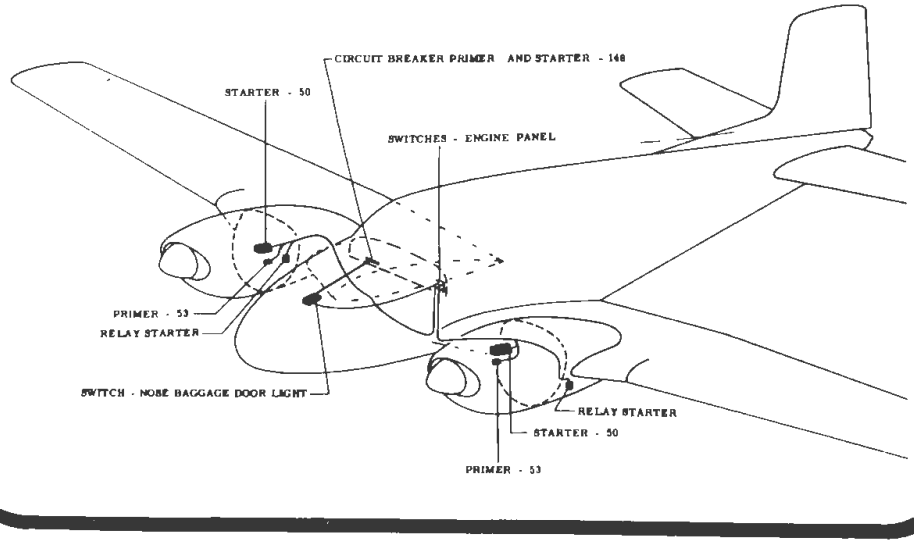
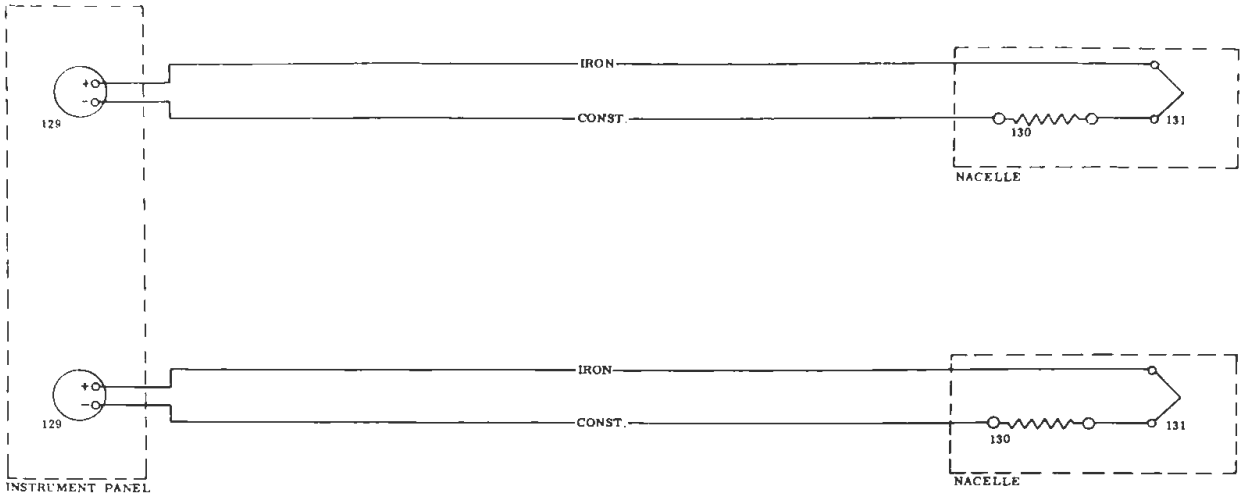




Figure 8-11. Starter and Primer Circuits



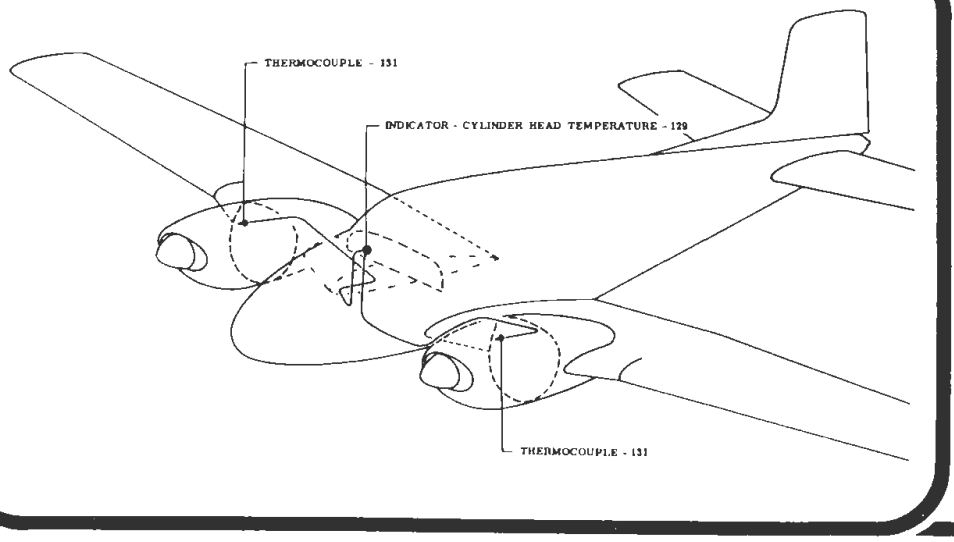
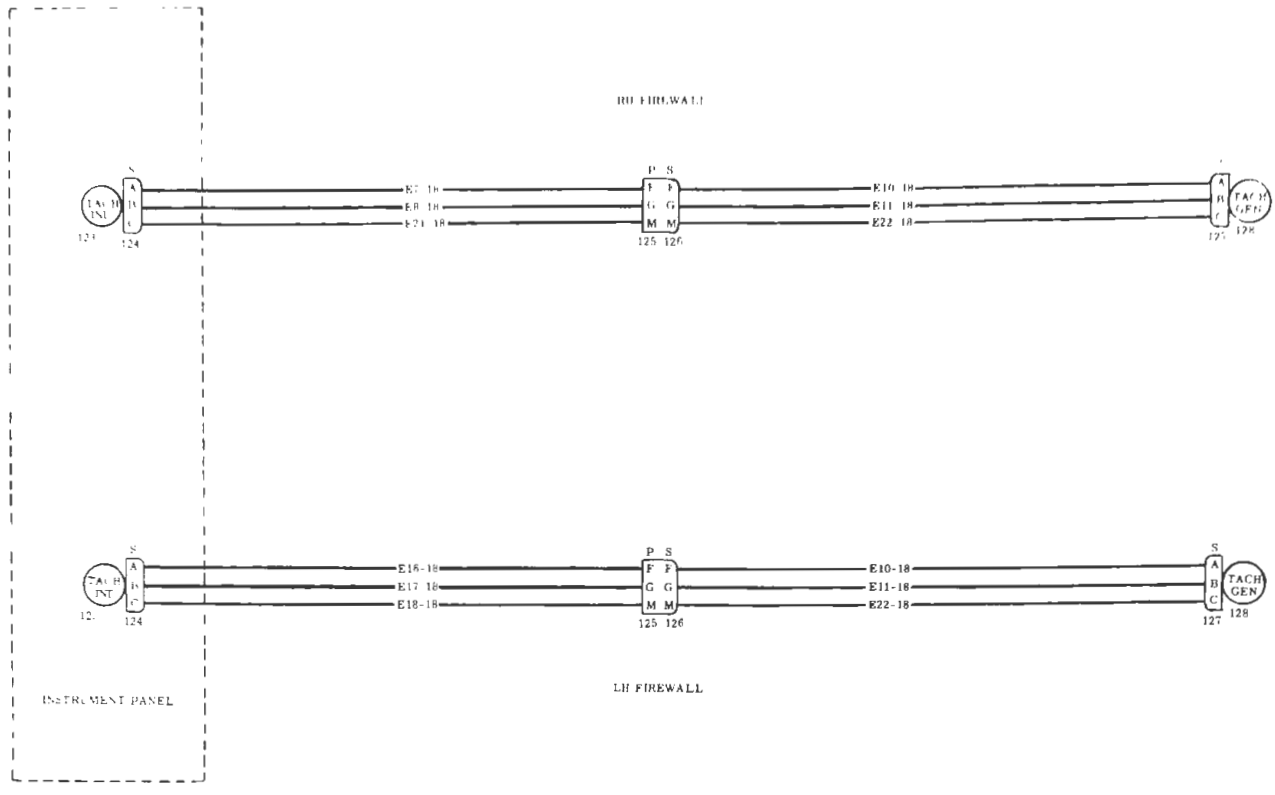




Figure 8-12. Cylinder Head Temperature Indicator Circuits



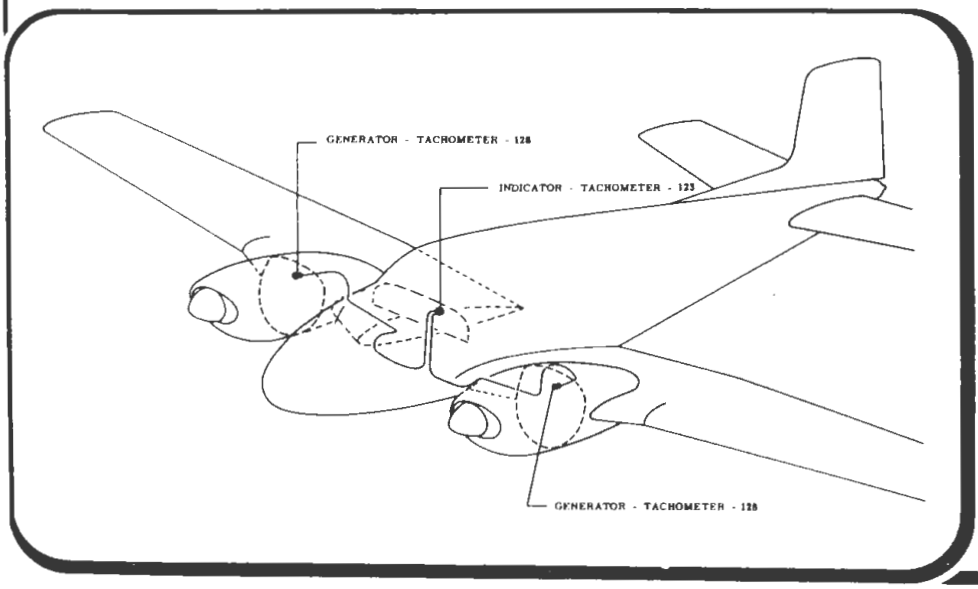
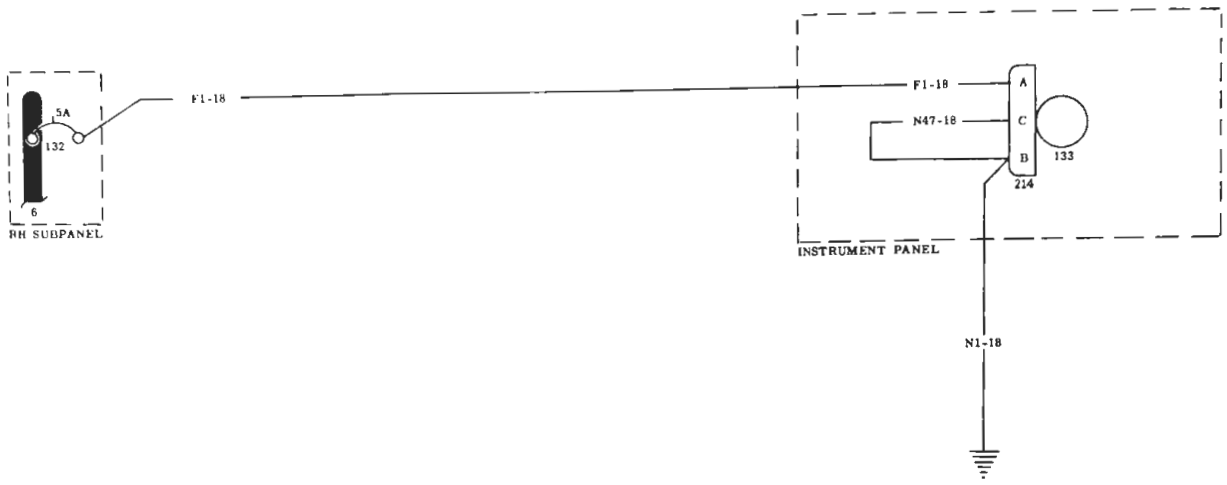




Figure 8-13. Tachometer Circuits



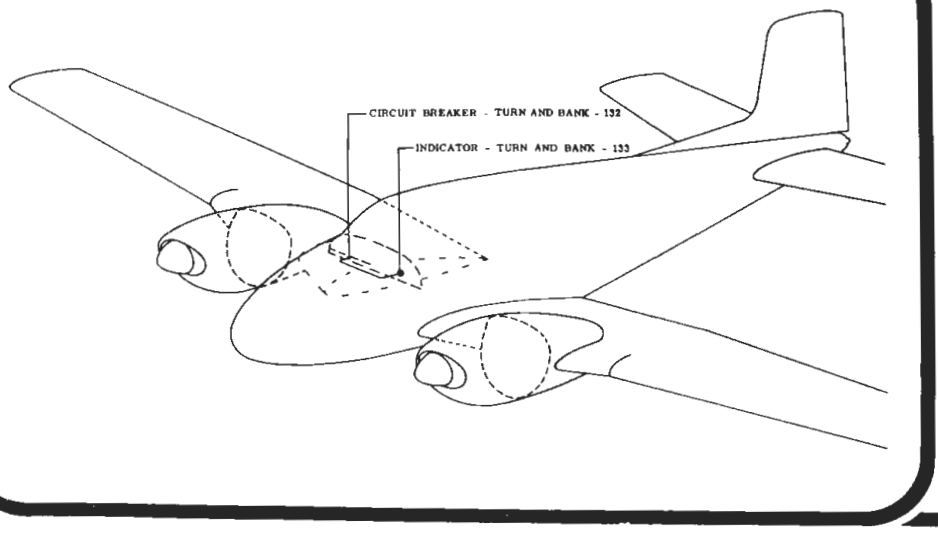
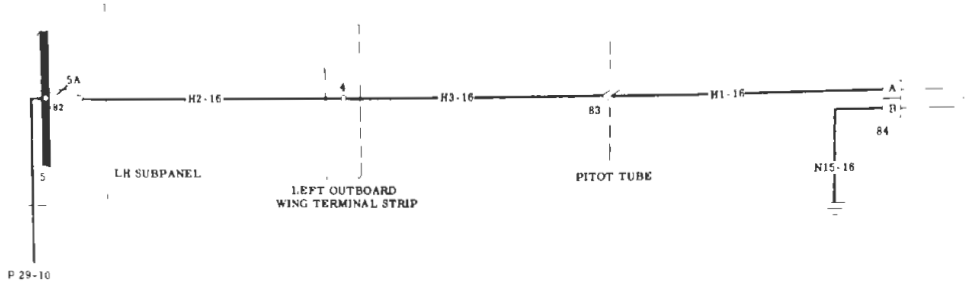
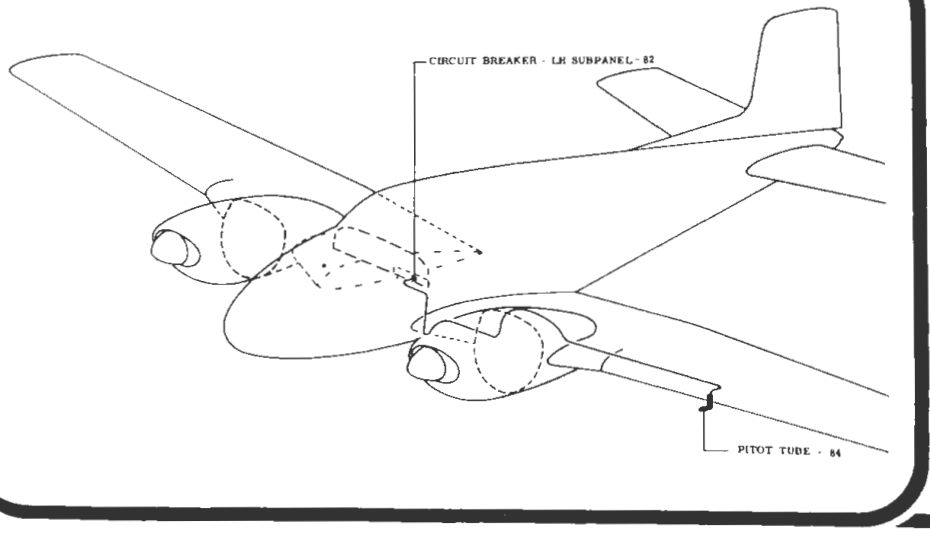



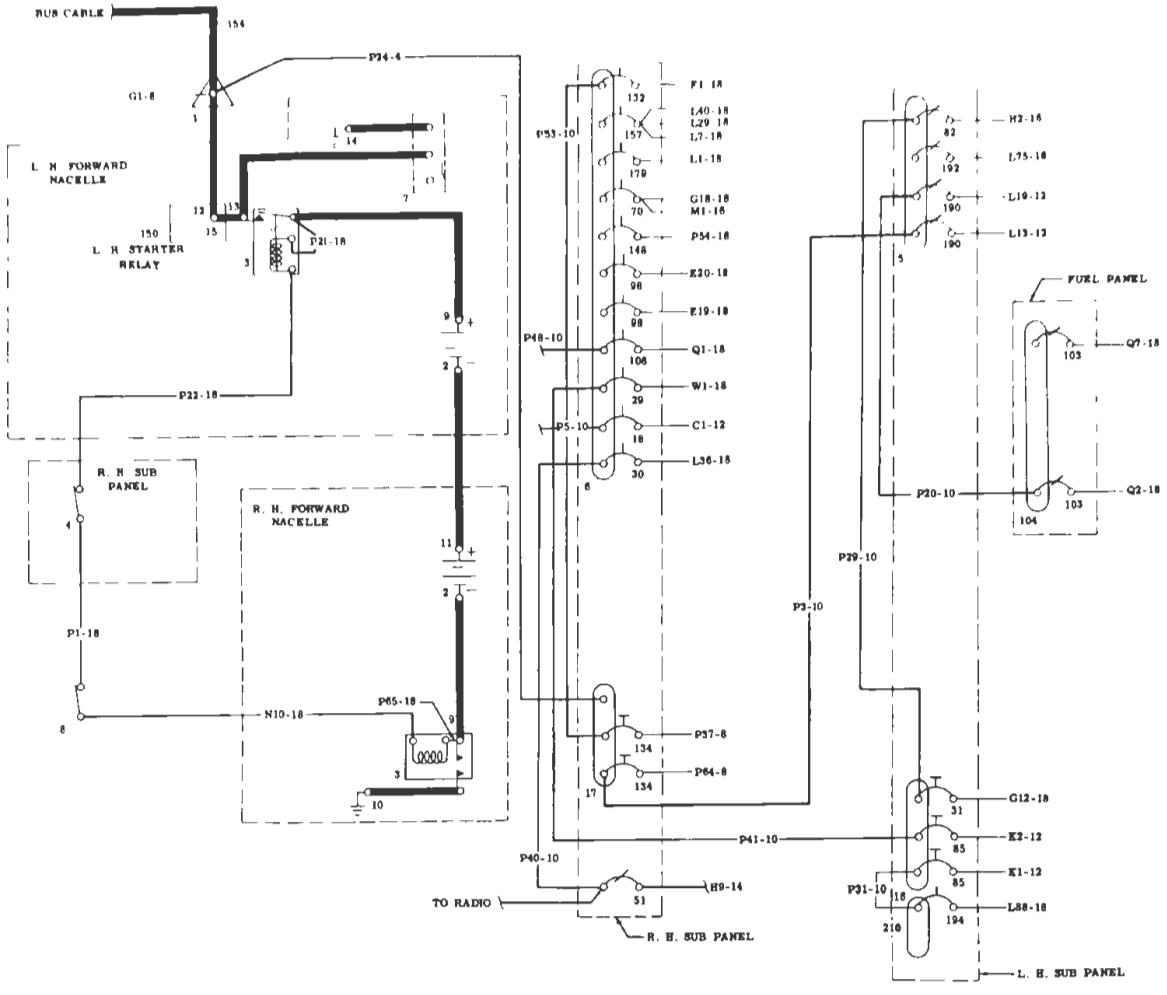

Figure 8-14. Turn and Bank Indicator Circuits




**NOTE:**
**4-RECEPTACLE AN3115-1**

Figure 8-15. Pitot Heat Circuit



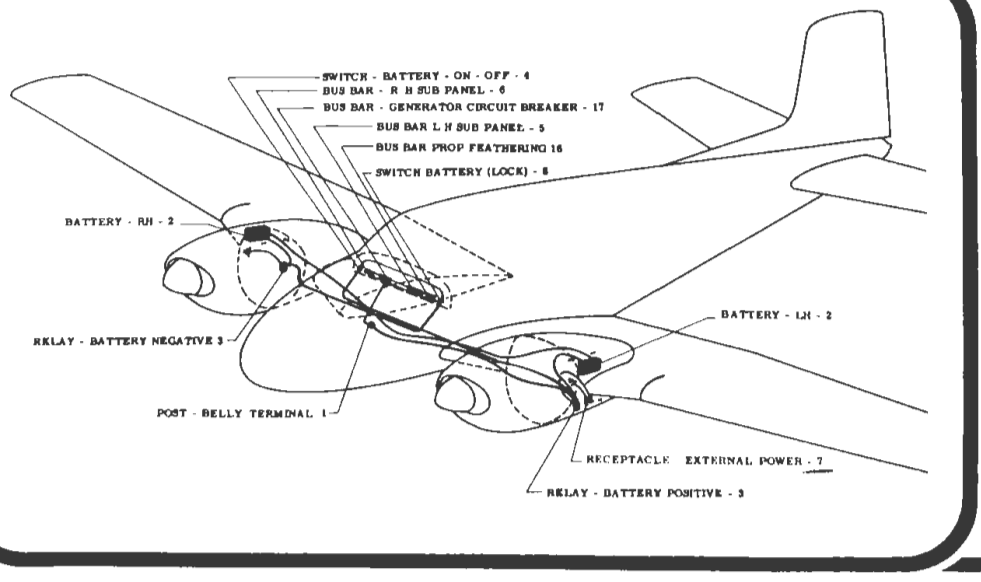


SWITCH - BATTERY - ON - OFF - 4
BUS BAR - R H SUB PANEL - 6
BUS BAR - GENERATOR CIRCUIT BREAKER - 17
BUS BAR L H SUB PANEL - 5
BUS BAR PROP FEATHERING 16
SWITCH BATTERY (LOCK) - 8
BATTERY - RH - 2
RELAY - BATTERY NEGATIVE 3
POST - BELLY TERMINAL 1
BATTERY - LH - 2
RECEPTACLE EXTERNAL POWER - 7
RELAY - BATTERY POSITIVE - 3

Figure 8-16. Power Distribution Circuit

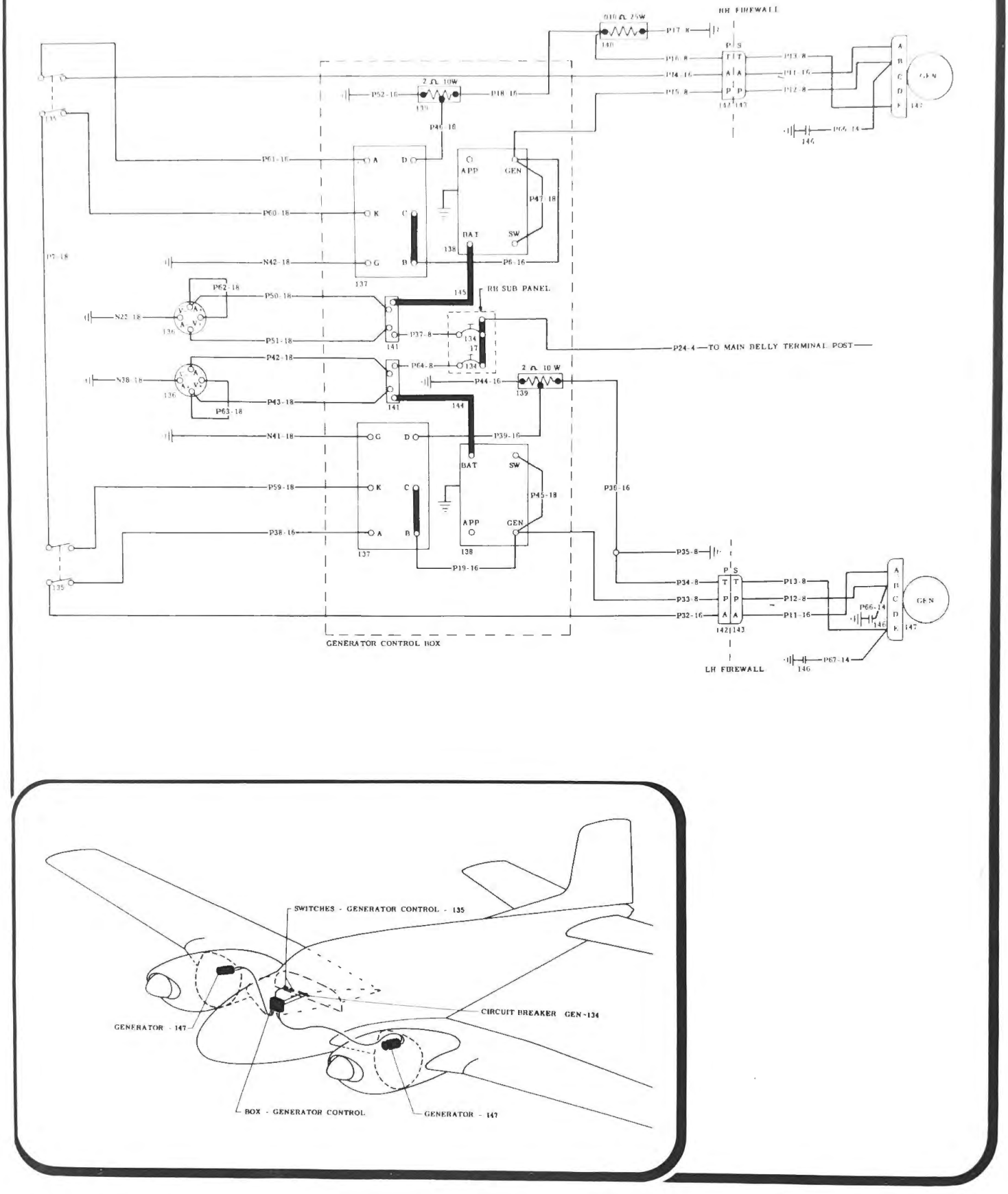
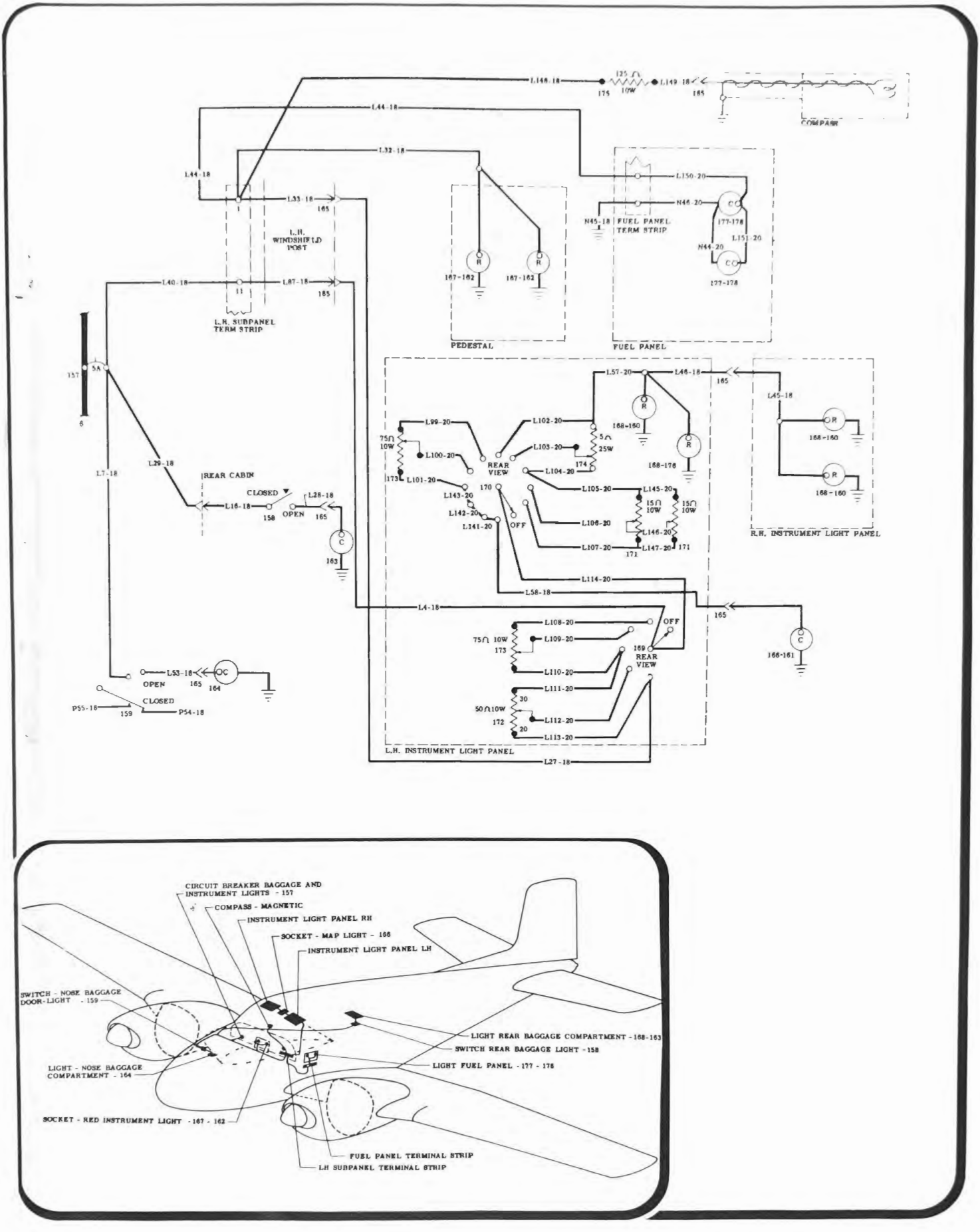



Figure 8-17. Generator Circuits





CIRCUIT BREAKER BAGGAGE AND INSTRUMENT LIGHTS - 157
COMPASS - MAGNETIC
INSTRUMENT LIGHT PANEL RH
SOCKET - MAP LIGHT - 166
INSTRUMENT LIGHT PANEL LH
SWITCH - NOSE BAGGAGE DOOR-LIGHT - 159
LIGHT REAR BAGGAGE COMPARTMENT - 168-163
SWITCH REAR BAGGAGE LIGHT - 158
LIGHT FUEL PANEL - 177 - 178
LIGHT - NOSE BAGGAGE COMPARTMENT - 164
SOCKET - RED INSTRUMENT LIGHT - 167 - 162
FUEL PANEL TERMINAL STRIP
LH SUBPANEL TERMINAL STRIP

Figure 8-18. Baggage, Red Instrument and Map Light Circuits

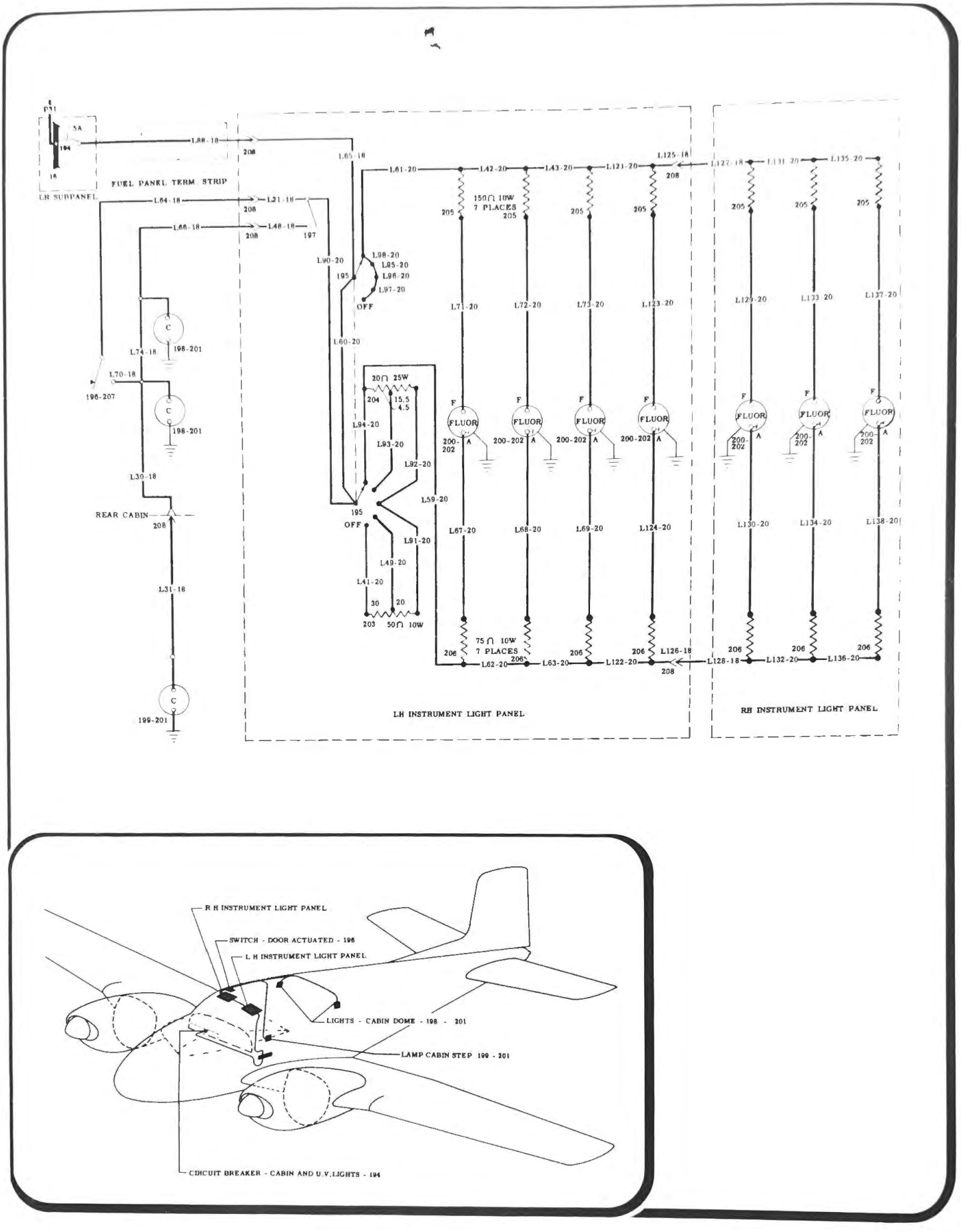
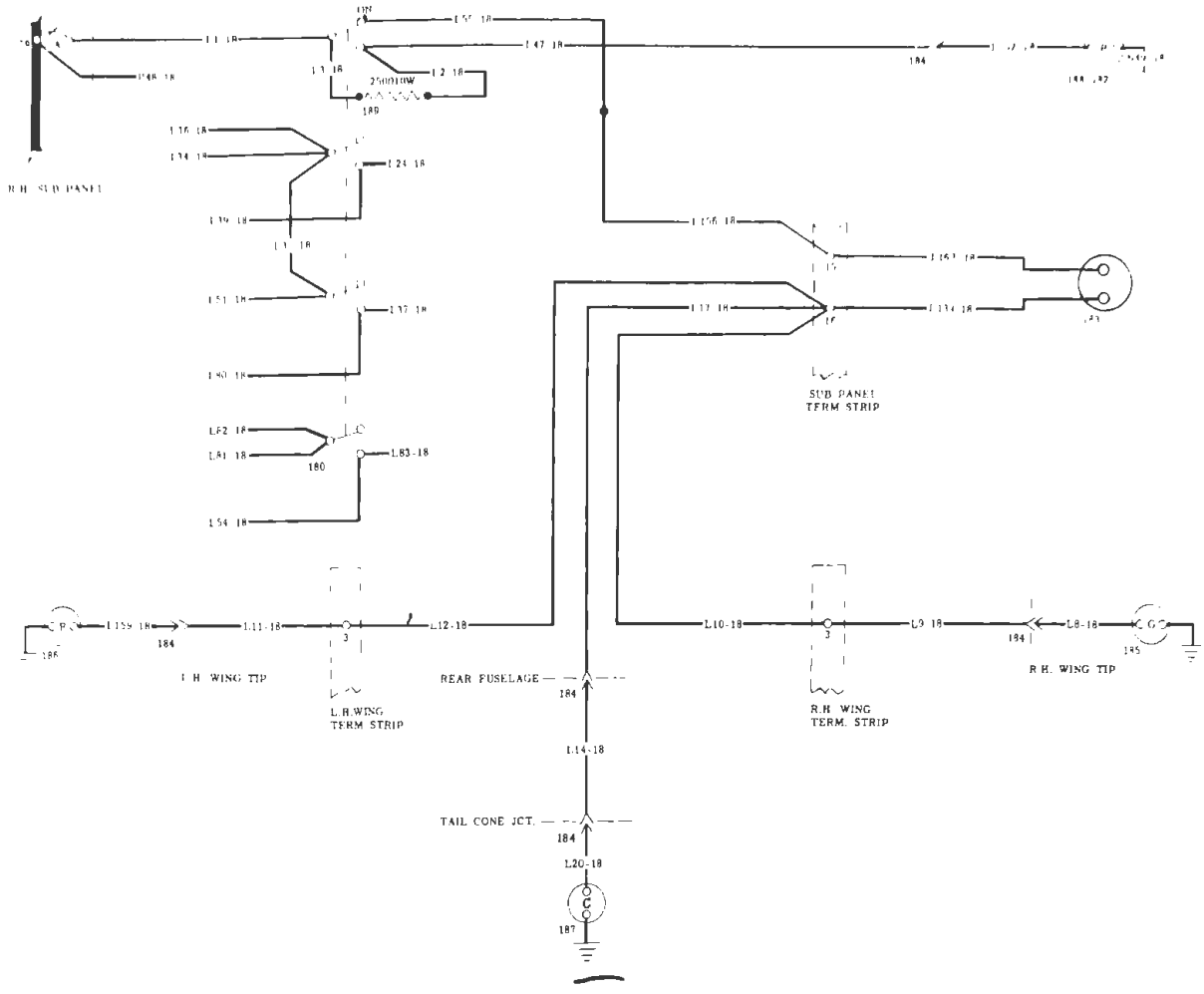



Figure 8-19. Cabin Dome, Cabin Step and Instrument Ultra-Violet Light Circuits



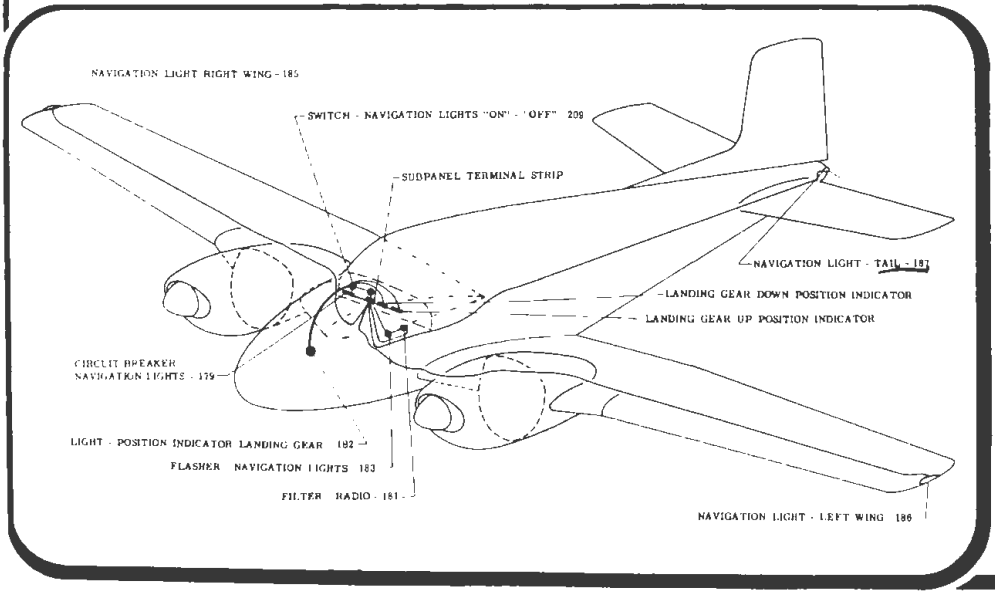
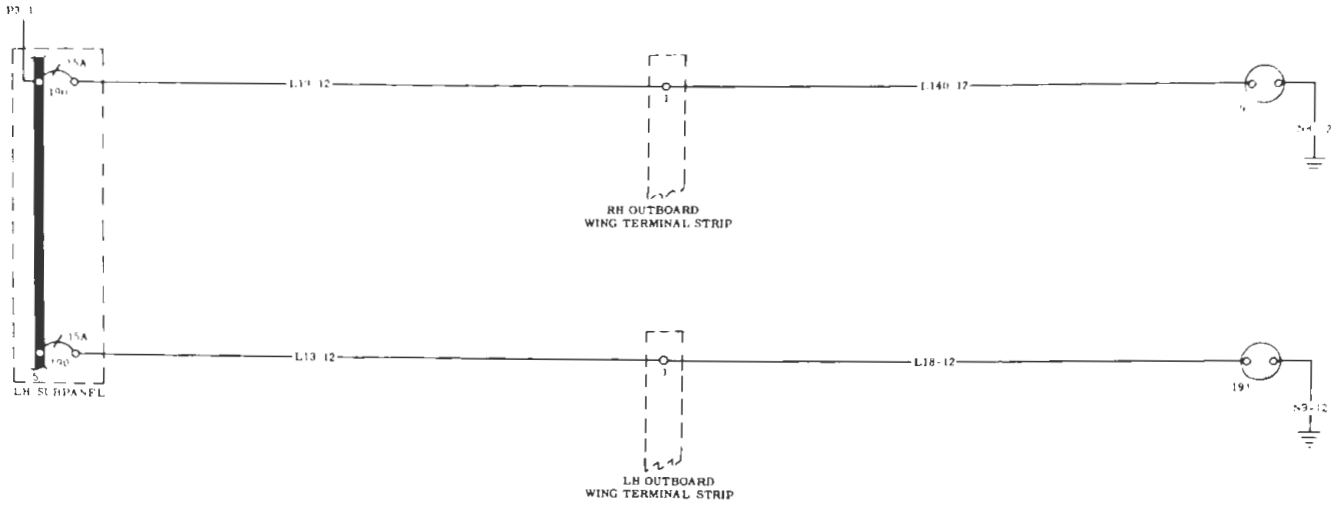


NAVIGATION LIGHT RIGHT WING - 185
SWITCH - NAVIGATION LIGHTS "ON" - "OFF" 209
SUBPANEL TERMINAL STRIP
NAVIGATION LIGHT - TAIL - 187
LANDING GEAR DOWN POSITION INDICATOR
LANDING GEAR UP POSITION INDICATOR
CIRCUIT BREAKER NAVIGATION LIGHTS - 179
LIGHT - POSITION INDICATOR LANDING GEAR 182
FLASHER NAVIGATION LIGHTS 183
FILTER RADIO - 181
NAVIGATION LIGHT - LEFT WING 186

Figure 8-20. Navigation Light Circuits



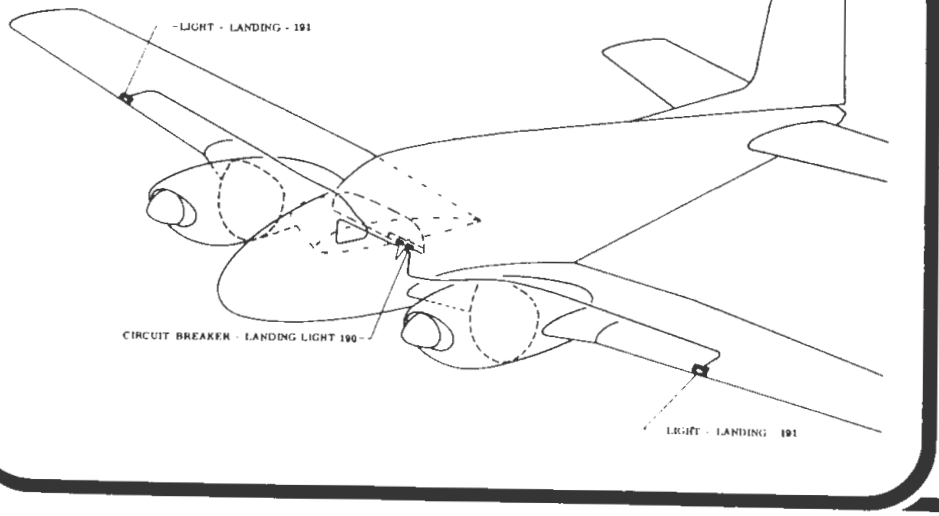




Figure 8-21. Landing Light Circuits

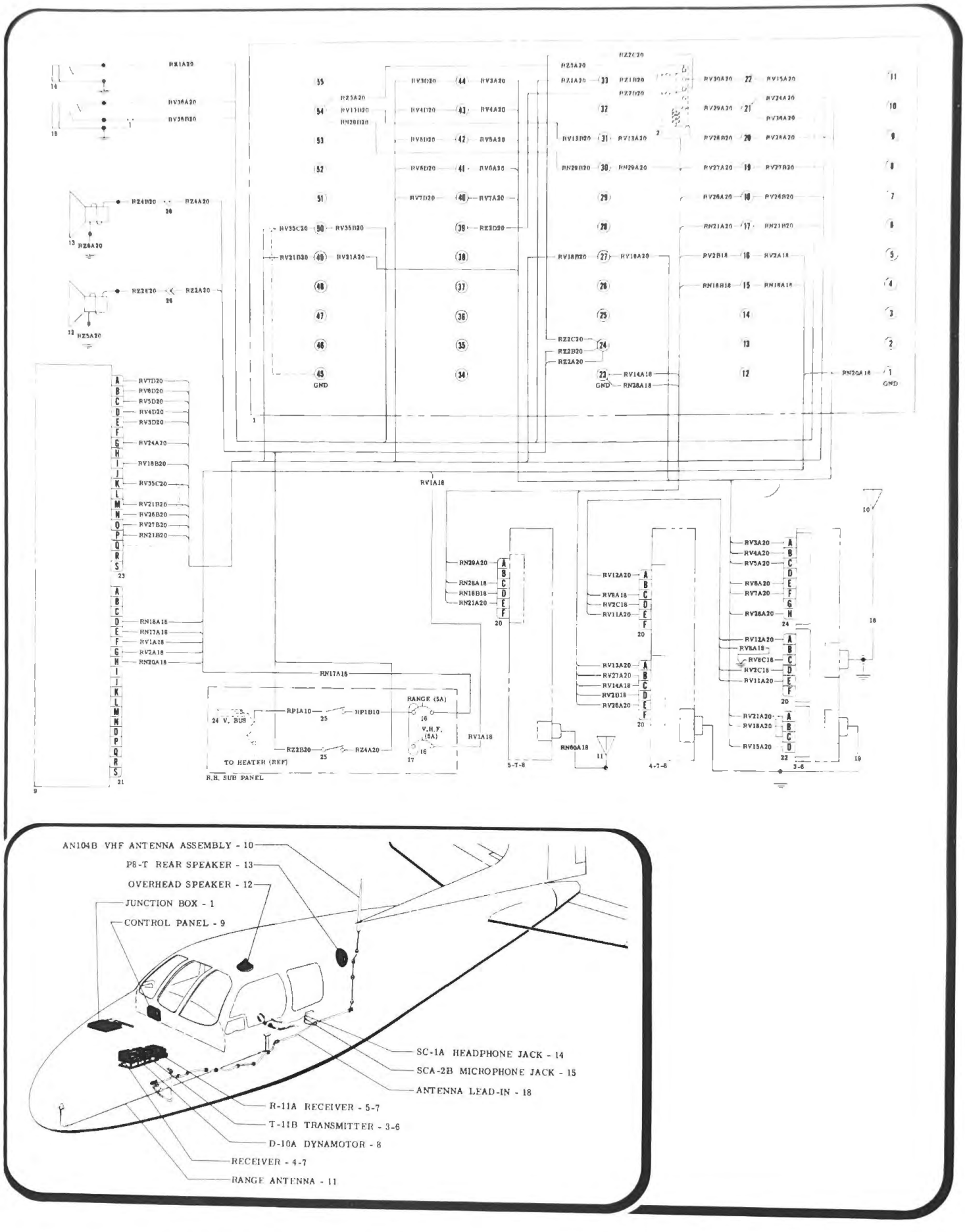



Figure 8-22. Basic Radio Circuit (ARC R-11A, R-15, T-11B Installation)